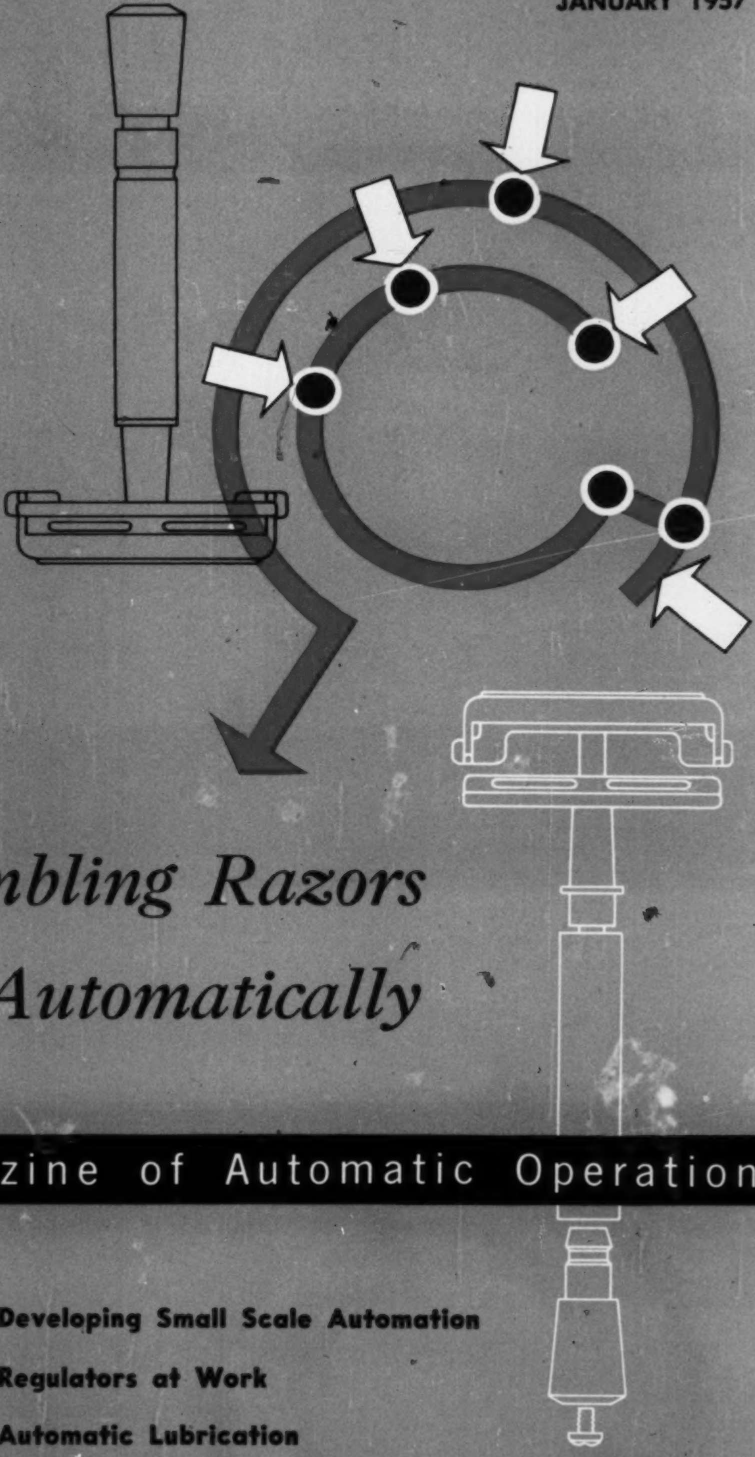
AUTOMATION

JANUARY 1957



Assembling Razors Automatically

The Magazine of Automatic Operations

- **Developing Small Scale Automation**
- **Regulators at Work**
- **Automatic Lubrication**
- **Preparing for Numerical Control**

CONTENTS — PAGE 3

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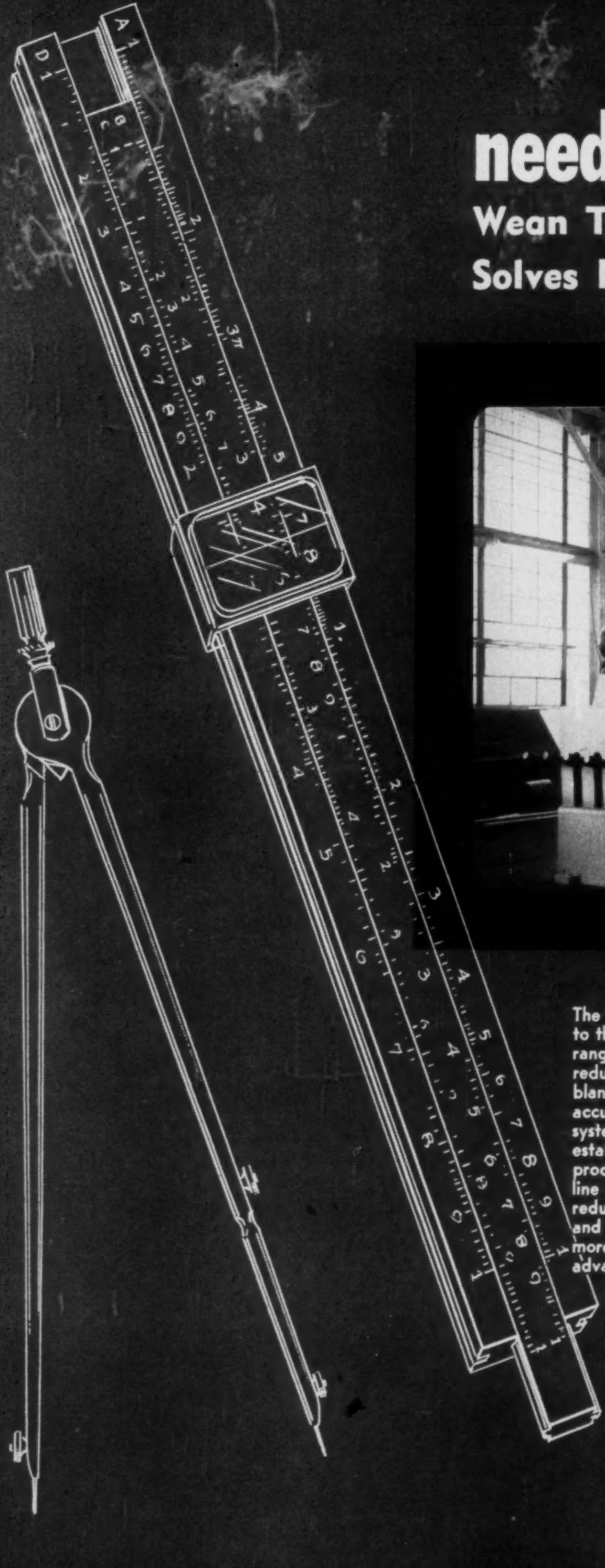
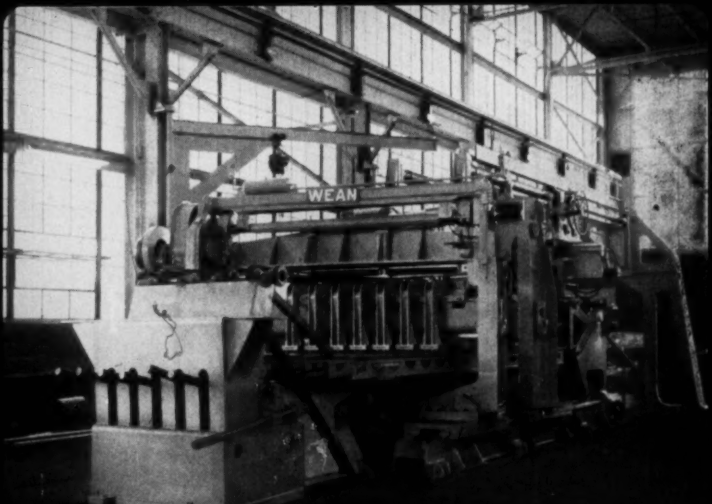


need an idea?

Wean Trapezoidal Shear Line Solves Problem for Auto Maker



The Wean Trapezoidal Shear Line was developed as an answer to the high speed blanking of irregularly shaped pieces in the broad range that can be described as trapezoids or parallelograms. This use reduces tremendously the cost of expensive die setup in major blanking presses. Two pieces are made at each index with the accuracy that can only be achieved by a measured length indexing system. The cut can range from 45° to 90° angles. The latter setting establishes the line as a straight cut-up unit with twice the normal production of conventional shear lines. At Wean, we consider this line as another important step forward in our policy of cost reduction through progressive engineering. People in the automotive and metal fabricating fields have come to look more and more toward Wean Equipment for spectacular advances in machinery for metal processing.

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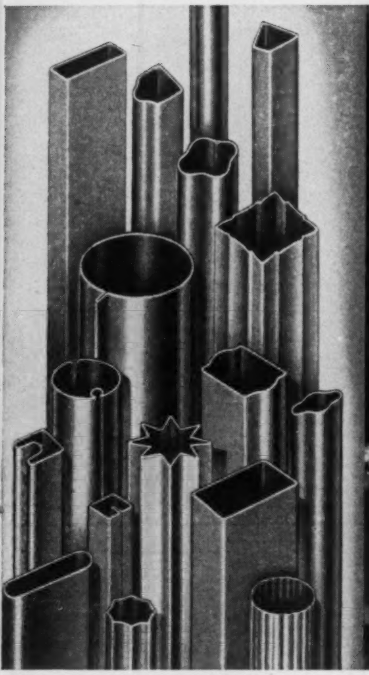
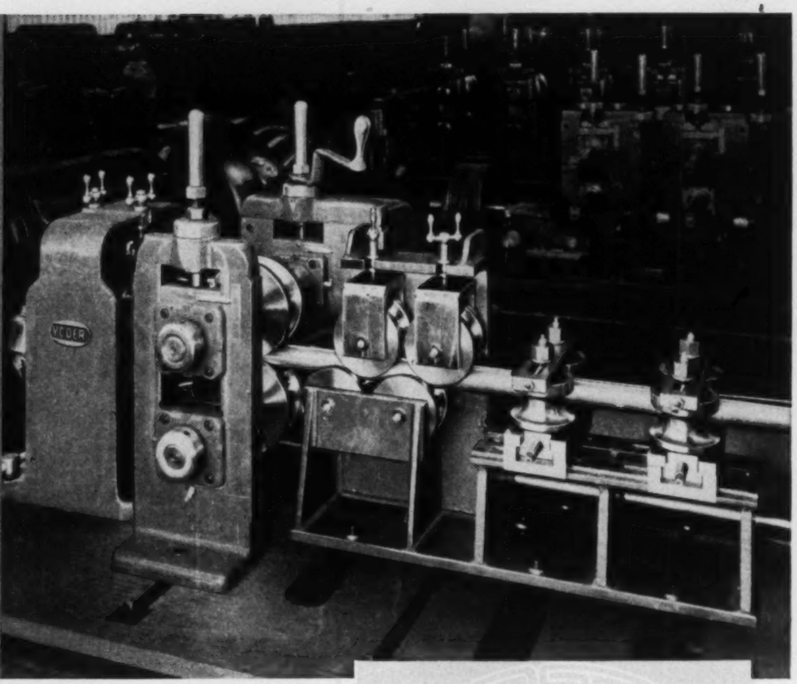
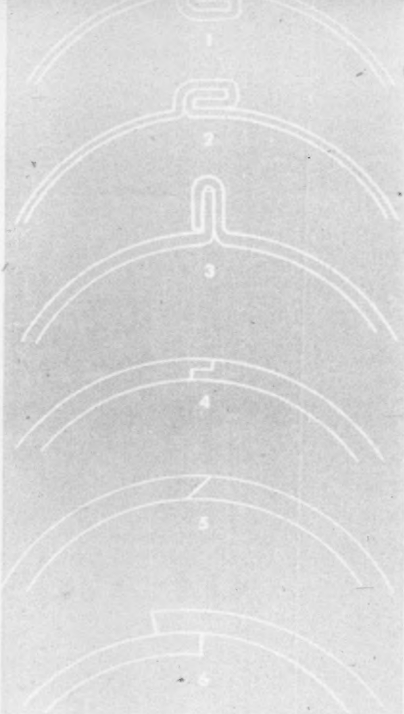




Lock-Seaming attachment at exit end of forming machine.



COLD ROLL FORMING TUBULAR SHAPES

Among the wide variety of things you can make on a Yoder Cold Roll Forming machine are round, square, oval, rectangular and other tubular shapes, such as illustrated at left above. The seams may be open, lapped, butted, dovetailed, interlocking, etc.—as indicated in Figures 1 to 6 at the right.

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ENGINEERING YODER MANUFACTURING

COLD ROLL FORMING MACHINES

ROTARY SLITTING LINES

PIPE AND TUBE MILLS—Electric Weld

JANUARY 1957
Vol. 4 — No. 1

AUTOMATION®

A PENTON PUBLICATION

The Magazine of Automatic Operations

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Size or Ingenuity, 39
EDITORIAL—small firms find automation application has few restrictions, least of all plant size or employment.

Developing Small Scale Automation, 40
F. F. WHITE—explains the main criteria for making automated production profitable on a small-scale basis.

Assembling Razors Automatically, 45
E. M. SULLIVAN and C. O. MERCHANT—AUTOMATION TODAY—in-line and rotary machines tooled to assemble complete product.

Organizing for Automation, 51
D. W. SHERMAN—development of machines, processes and factories must be integrated with other technical specialties.

Regulators at Work, 54
ANTON G. SEIFRIED—applications of regulating systems designed to improve continuous processing efficiency.

Automatic Lubrication, 61
W. O. WRIGHT—packaging machine examples reveal dependence of highly automated equipment on adequate lubrication.

Switching Functions, 65
JAMES R. WALKER—part three—diagrams and descriptions of four circuits that make use of magnetic amplifiers.

Automation in Action, 68
PICTORIAL PRESENTATION—buffing, pallet handling, annealing, scrap collection, pneumatic transfer, and suspended ovens.

Preparing for Numerical Control, 70
R. E. REITER—parts machining by such systems involves more than physical development and possession of equipment.

Continuous Inspection and Sorting, 75
T. G. SLATTERY and A. JOYCE—magnetic memory device links remotely located observation and rejection stations.

REGULAR DEPARTMENTS

Automation Outlook, 4
Automation News, 9
Reader's Reply Card, 17
Meetings and Events, 24
Detroit Dateline, 29
Notes from Britain, 35
New Equipment, 83
New Components, 97
New Literature, 114
Abstracts, 118
Press Unloaders and Die Design
Controls in Work Handling
Considerations in Equipment Replacement
Patents, 127
Editorial Index, 128
Books, 131

automation outlook

IMPROVE PRODUCTIVE EFFICIENCY

". . . it has conjured up visions of pushbutton factories all but devoid of human beings. They think it is a threat to future job security. Yet, it has been estimated, on the basis of present population and productivity trends, that unless we improve our productive efficiency the country will face a labor shortage beginning sometime in the mid 1960's . . . So our worry perhaps should be, can we improve productive efficiency fast enough? . . ."—*Sherrod E. Skinner, vice president of General Motors, in charge of the Accessory Group.*

ANSWER THE NEED

". . . clearly, to reassure a justifiably skeptical management, there should be a 'foot in the water' approach to automation instead of a 'dive into water' which may prove cold. Small-scale automation is the answer to the need for a modest and reasonable approach. It can be very profitable although simple. It can be applied to existing machinery and processing techniques. The moderate capital investment can be returned quickly and reinvested as fast as desired . . ."—*F. F. White, vice president-engineering, Automation Development Corp., see page 40.*

PERFORMING IN UNISON

". . . a most significant and common characteristic of automation is that of integration. The design of the product, the tools, the machines, and the handling equipment, must all be integrated to mesh together and perform in unison under the direction of suitable controls. The resulting entity is, in fact, a single integrated machine . . ."—*D. W. Sherman, president, A. O. Smith Engineering Service Corp., see page 51.*

CONSIDER STANDARDS EARLY

". . . with the advent of complex mechanisms required for printed circuitry, automation, electronic computers, and utilization of nuclear energy, it is highly desirable that standardization be considered in the early stages of research and design . . ."—*M. S. Gokhale, RCA Victor Div., president of the Standards Engineering Society.*

USE THE BEST SOLUTION

". . . sometimes we recommend to a customer that the best solution to his problem is not complete automation, but partial automation. Our preliminary study may show, for instance, that ten operations are involved. We can automate nine of these operations at an average cost of $5,000 per operation—or $45,000 for all nine. To automate the tenth operation may cost $30,000, in which case we might suggest that the customer continue to perform this operation manually . . ."—*Leonard Swanson, president, Swanson-Erie Corp.*

PUSHBUTTON POTENTIAL

". . . we must resolutely face the fact that we can stockpile only a very few of the tools we may require under the split-second urgency of a possible pushbutton conflict. *Pushbutton potential* is, in its simplest meaning, a standby reserve of versatile, automated production capacity that can well be our most important secret weapon . . ."—*W. Fay Aller, vice president and director of the research div., Sheffield Corp.*

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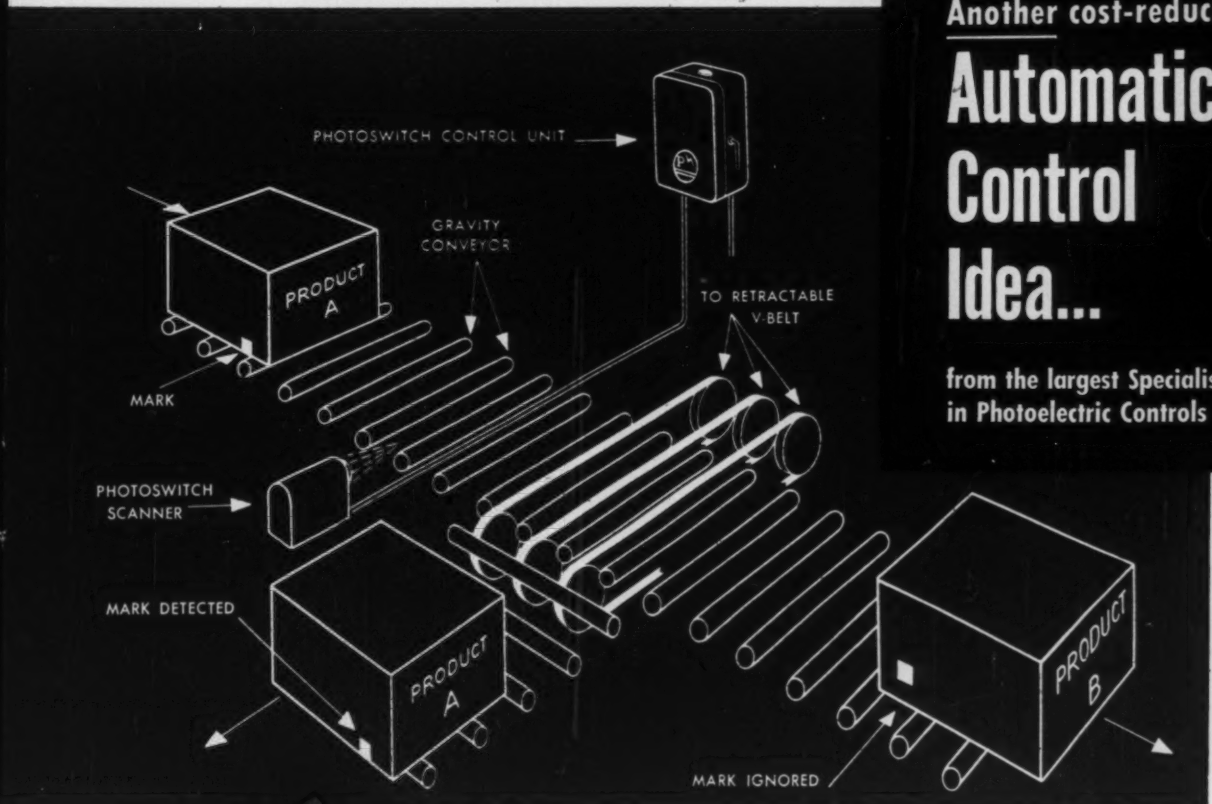
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PRODUCT A
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MARK
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Solution: Photoswitch photoelectric scanners, positioned along the main conveyor carrying mixed cartons, detect marks printed in identifying positions on the sides of the cartons. The scanner for each product type is keyed by switches to see a mark printed only in the position that identifies that product. It ignores marks printed in different positions which identify other products. When the proper mark is detected, a Photoswitch Control Unit causes take-off V-belts to rise between the main conveyor rollers shunting the carton to the correct secondary conveyor for automatic palletizing and storage.

Results: 1. Increased output. 2. Reduced labor costs. 3. Error-free sorting.

This control design is typical of thousands of successful Photoswitch Systems for Automatic Electronic Control of Machinery and Processes. In Photoswitch's wide variety of "ready-to-use" photoelectric controls, liquid level controls and electronic timers, you will find controls that meet your requirements exactly. For the solution of your control problems, see your Photoswitch representative.

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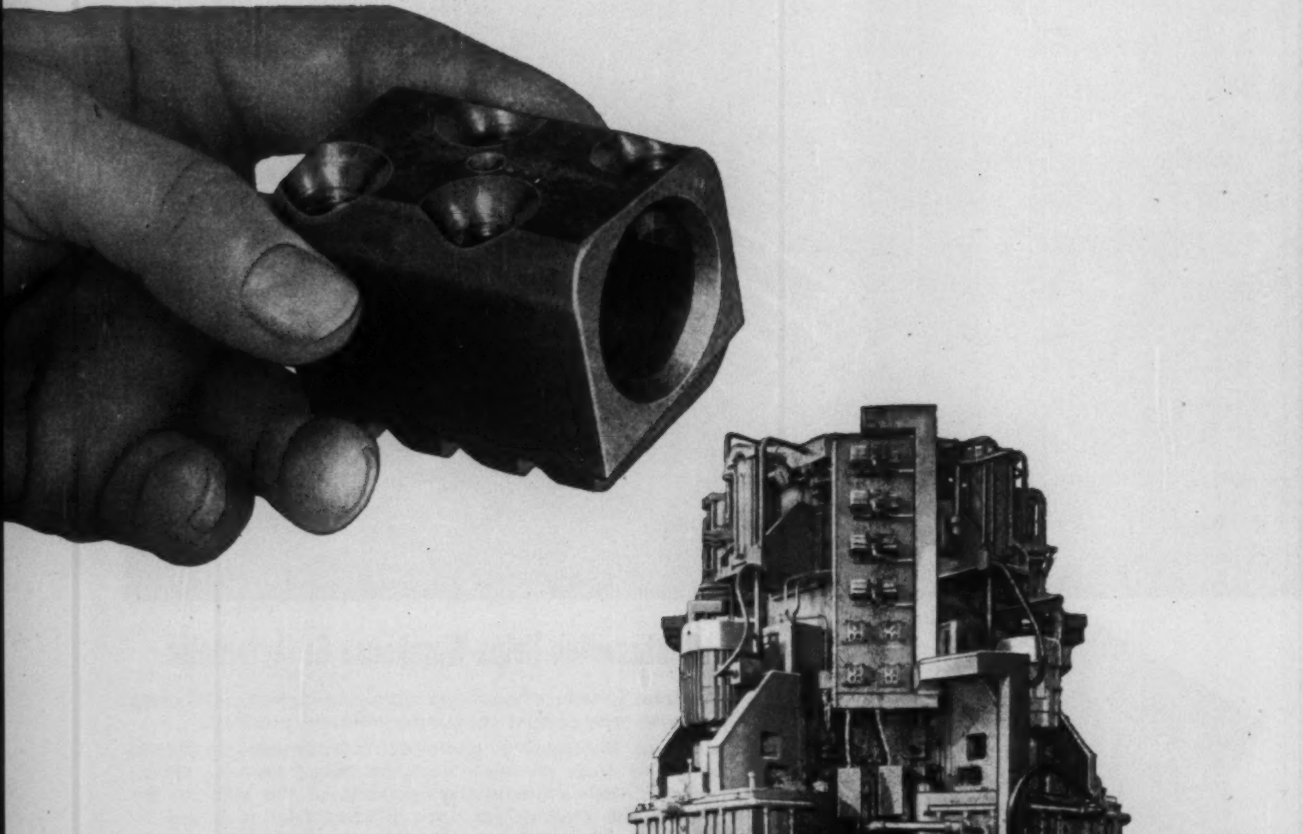
Simplified Automation in Successfully Applied in New


SNYDER
SNYDER

Machining Small Parts is Snyder Center Column Machine

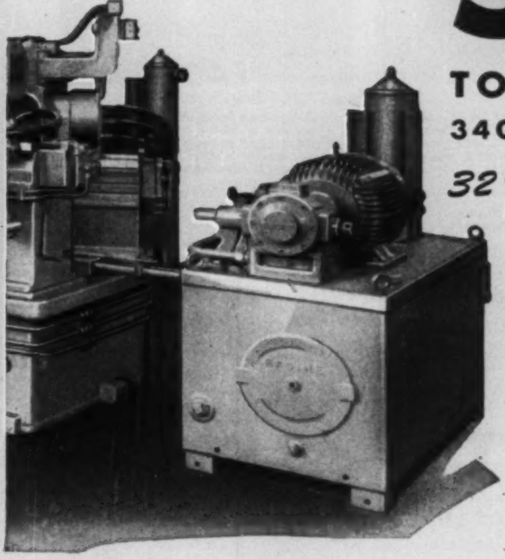
The principle of automation is inherent in the design of this machine which performs, in its continuous 16-station cycle, 25 operations equalling the performance of two or three ordinary machines. The workpiece is a small automotive steering gear ball nut 2½″ x 1⅝″ x 1⅞″. Production is 331 pieces per hour.

Three workpieces are loaded and automatically clamped in each of the 16 fixtures on the 96″ index table. A unique feature of the machine is its special heavy-duty cast iron center column 108″ high and 48″ in diameter. This massive column is necessary to withstand the high vertical thrust loads imposed by six heads mounting 9 spindles each which drill, flat bottom drill and radius chamfer four recirculating ball holes and tap drill and chamfer one hole in the same part face.

The table is also designed to withstand high horizontal thrust loads for core drilling, chamfering and reaming the threaded shaft hole which requires three spindles for each of the seven Snyder heavy-duty way type units.

The machine, one of the largest of its type, weighs 50,000 lbs., requires 288″ x 312″ floor space and stands 156″ high overall.

If you have an automation problem in machining small parts, this type of Snyder machine may be the right answer.



SNYDER

TOOL & ENGINEERING COMPANY

3400 E. LAFAYETTE • DETROIT 7, MICHIGAN

32 Years of Special Machine Tools with Automation

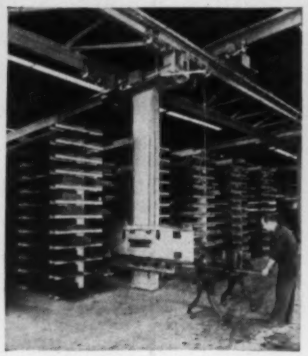
Circle 614 on Inquiry Card

Neat, convenient and efficient steel bar storage stacked mechanically by the American MonoRail Stacker in narrow aisles

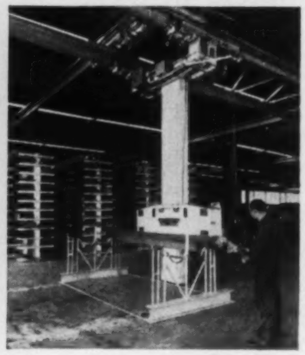
HOW'S THIS FOR STEEL STORAGE!

American MonoRail engineers, working with Hawkridge Brothers Company, designed this system for storing bars, rods and other long steel shapes.

Note the extremely narrow aisles and maximum height of racks. Bars and rods, 20-22 feet long, are placed in pans 18 feet long. The American MonoRail Stacker transfers these pans to either side of an aisle for storage.



MonoRail Stacker forks support bar in saw. Saw with extension rolls to any convenient spot in the warehouse.



American MonoRail Stacker lowers a banded bundle of bars over prongs which ingeniously splits bands, lets bars roll into trough for pick-up in a tray.

Photos: Courtesy of Hawkridge Brothers Company, Waterbury, Conn.

Member of Materials Handling Institute - MonoRail Association

OVERHEAD HANDLING EQUIPMENT

AMERICAN
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COMPANY

ATHENS AVENUE, CLEVELAND 7, OHIO (IN CANADA—CANADIAN MONORAIL CO., LTD., GALT, ONT.)

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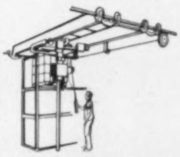
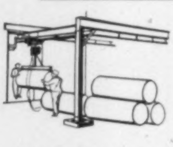
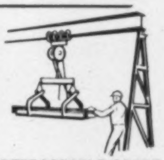


STACKER CRANE



MANUAL MONORAIL



RETRACTABLE CRANE

Circle 557 on Inquiry Card

AUTOMATION news

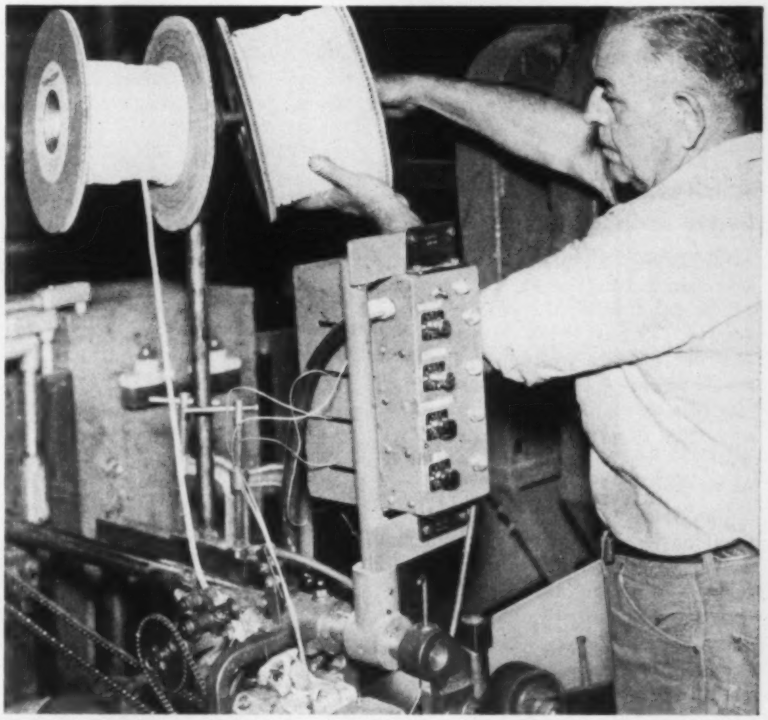
Today's events and developments in the field of automation

Adhesive In Coils Permits Increased Machine Speeds

UNIQUE METHOD of applying adhesives, proved in use by the shoe industry, is now available to industry in general. The method utilizes a thermoplastic adhesive which is fed from a coiled form to a special applicator directly coupled to a base machine. Marketed by the Industrial Sales Div. of the United Shoe Machinery Corp., the thermoplastic adhesive is a dry solid in cord-like form wound on a coil. This coil is fed into an applicator consisting primarily of melting and applying elements together with necessary heat controls. Within the applicator, the adhesive is melted and applied in a closely controlled manner.

The applicator device can be applied to existing equipment or provided as especially engineered units for integral installation on new machines. With this system, application is uniform through any speed range when the applicator drive is taken from the base machine. This means that with new machine designs, machine speed will no longer be limited by considerations involving the adhesives.

A number of advantages to the handling of cement in coiled form are obvious: Preparation is limited to the placing of a reel on a spindle. No daily cleaning of machinery, receptacles, storage or mixing areas is required. Only a small amount of cement is subjected to heat and is in molten form at any one time. There can be no change in composition by evaporation or settling at the point of use.



SPECIAL equipment, capable of attachment to existing packaging machines, is designed for the continuous and controlled feeding, melting and application of a solid adhesive in coil form. The thermoplastic adhesive is fed from the reels into a melting body containing seven heating units controlled by four thermostats. This concept of applying adhesive, developed by the United Shoe Machinery Corp., is based upon techniques proved by the shoe industry.

Primarily, however, the system provides for better control of adhesive operations. The rate and degree of flow are determined by seven heating units, controlled by four thermostats, located within the applicator at carefully selected points to maintain optimum cement applying temperatures.

Trends In Material Handling

SALES OF material handling equipment will be 10 per cent higher in 1957 than the record breaking sales of 1956, according to the Board of Directors of the Material Handling Institute Inc. The directors point to four major contributing factors as the basis for their optimism: Material handling still offers the greatest opportunity for reduced cost and increased productivity; automation of single or multiple processes places greater demands on handling systems required to move materials to and from the processes; there is an increased interest in handling, storing, shipping and receiving of materials in unit loads; and the rising cost of manual handling plus the increasing labor shortages continue to force the upgrading of labor to higher skills and more productive work.

The Board also points out that ease of maintenance is receiving top attention by handling equipment designers; other design trends include easier, faster, and safer operation of equipment. Additional improvements on equipment expected in 1957 will include mechanical and electronically controlled transfer mechanisms, improved dispatch and system controls, and more versatile truck and crane attachments.

Automatic Insertion of New Sleeve Bearing Lubricant

METERING of lubricants to sleeve bearings is traditionally by the use of die cut felts and wool or cotton wastes. The Fluidwick Co., Detroit, has developed a system for automatic injection of a precise quantity of a special lubricant form into any type of sleeve bearing cavity which improves upon the traditional method.

The lubricant used is a blended combination of cellulose base fibers and a highly refined, paraffinic base turbine quality mineral oil. The oil contains both oxidation and corrosion inhibitors. The liquid lubricant flows readily and completely fills the bearing cavity.

Special equipment has been designed to insert the combined lubricant and wicking material into the bearing. Die cut felt and similar wicking materials must normally be inserted by hand—such assembly and subsequent lubrication might require as many as four individual operations during production. With special equipment for the new liquid Permawick, no special skill is required by an operator. A dial on the automatic inserting machine is set to the required quantity and an amount is injected into the cavity within 0.5 per cent of the desired quantity.

Advantages in the use of this type of lubricant include: Reduction of the number of production operations in inserting the lubricant and wicking material; reduction in inventory; cleaner working areas; more positive oil circulation; better oil filtration; and quieter bearing operation.

Data Recording System Speeds Management Reports

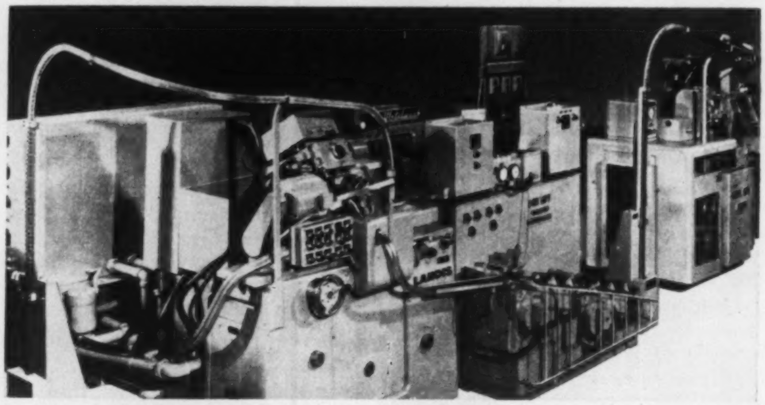
ALL RIGHTS, patents and equipment of an electronic transaction transmitting system developed by the Hillyer Instrument Co. have been acquired by the Stromberg Time Corp., a subsidiary of General Time Corp. The system is designed to close the communications gap which now exists between factory workers and centralized data processing systems. Called the Transacter, the system permits instantaneous transmission of critical cost and payroll accounting data to a central receiving recorder, making possible a complete up-to-the-minute control of an entire accounting operation.

As visualized in use, transmitting equipment will be installed at strategically located work centers throughout the plant. When a production operation is completed, data tags would be inserted in the transmitter. The information contained on the tags may be reproduced at very high speed at a central tape punch which then may be used to create punched cards for input to electronic computers, or may be automatically transmitted over a considerable distance by wire line transmission. Up to 50 Transacters may transmit to a single receiver, where their messages would be recorded in the order in which they are received. With this system, it will be possible to automatically record, without human intervention, cost accounting, payroll, inventory and other accounting data thereby making facts rapidly and readily available to management.

Machine Tool Shipments Show Substantial Gain

TOTAL 1956 shipments of machine tools sold through distributors exceeded 1955 shipments by substantial margins in most areas of the United States and Canada, according to year-end reports from 22 regional chairmen of the American Machine Tool Distributors' Association. **J. F. Owens Jr.,** president of the Association, has identified two factors which contributed principally to the year's increase in shipments. One was the fact that industry needed and accepted new engineering improvements in machine tools to improve efficiency and cut costs in the face of increased labor and material costs. The bulk of the year's shipments consisted of newly engineered machine tools that met these requirements. The second major factor was tax depreciation.

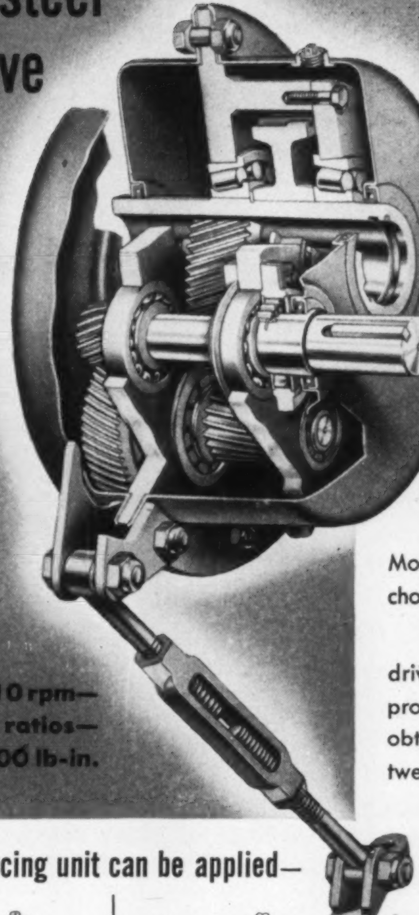
On the basis of the present expansion plan of the manufacturing



USE of extruded plastic tubing in conveying parts between operations in the manufacture of bearings illustrates the utility of plastics in automation. In the picture, bearing rings are pneumatically conveyed through the tubing which has been extruded to a special shape and formed by the user for the ideal path between machine elements. The plastic tube, a product of Jessall Plastics Inc., Kensington, Conn. is hard, durable and noncombustible. Should oil or residue accumulate in the tubing, compressed air will quickly blow it out.

The FALK all-steel Shaft Mounted Drive

- *Versatile*
- *Efficient*
- *Economical*
- *Compact*



SIX SIZES—½ TO 30 HP—420 to 10 rpm—single and two double reduction ratios—output torque ratings up to 21,000 lb-in.

To Plant Engineers:

The versatility of the Falk Shaft Mounted Drive makes it the practical choice for many machines in your plant.

This compact unit mounts on the driven shaft, thereby solving many problems of restricted space. You can obtain almost any output speed between 420 and 10 rpm by selecting the proper single or double reduction unit and the proper sheave or sprocket ratio.

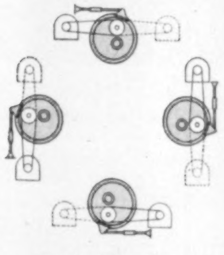
Do you need both horizontal and vertical drives? Standard Falk Shaft Mounted Drives are available for either application; or you can easily convert a horizontal unit to a vertical unit, right in your plant.

Initial cost is low, you get immediate delivery from shelf stock, and installation is quick and easy.

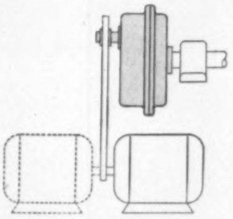
★

FALK Shaft Mounted Drives are available from factory and distributor stocks *from coast to coast*. See your Falk Representative or Distributor—or write direct for your copy of **Bulletin 7101.**

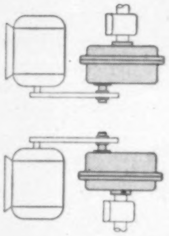
A few of the many ways this reducing unit can be applied—



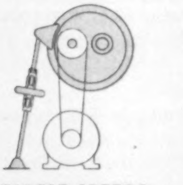
ANY POSITION



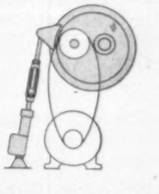
MOTOR EXTENDED —or below the unit



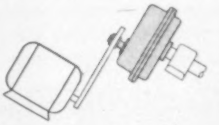
VERTICAL—UP or DOWN



VARIABLE SPEEDS... through use of variable-pitch sheaves—automatic belt adjustment with tie-rod adjustment



OVERLOAD RELEASE... that will slacken belts and cut off power if overload occurs



INCLINED SHAFT... Any standard unit can be mounted in vertical or inclined position by a simple rearrangement of oil drains

THE FALK CORPORATION, 3001 W. CANAL ST., MILWAUKEE 1, WIS.

Representatives and Distributors in Most Principal Cities

Manufacturers of

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- Weldments
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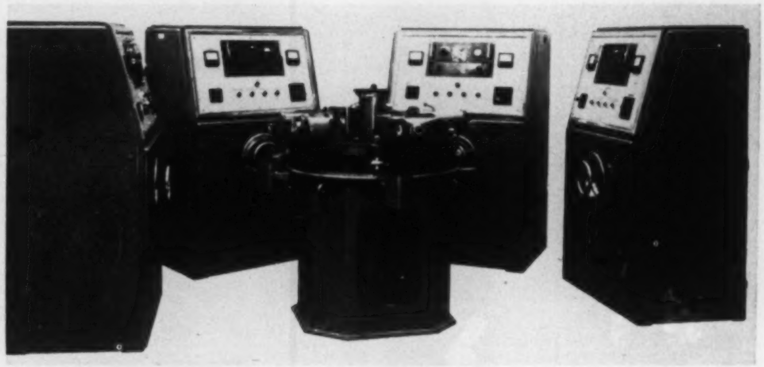
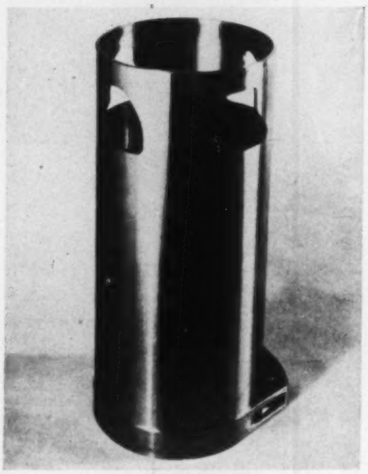
Circle 558 on Inquiry Card

FALK

...a good name in industry

industries that the distributors serve in their respective areas, most distributors forecast that their 1957 shipments will at least maintain 1956 levels, and might increase from 5 to 25 per cent over 1956 in regions where continued expansion is in sight for metalworking, electronics, electrical equipment, aircraft, automotive, petroleum and chemical industries.





FOUR PORTS in a hardened nitride steel sleeve are machined simultaneously by electronic erosion in an improved production setup. High frequency generating units supplied by Abaco Industries Inc., Elmhurst, N. Y. permit the drilling of four shaped port openings after final nitriding heat treatment at a saving of 237 minutes in production time per cylinder. Previously, the port openings were stamped out of a rough, soft cylinder liner and followed by 11 successive operations for inside and outside grinding, deburring and straightening metal deformations due to stamping and heat treating operations. Rejects ran over 10 per cent. With the improved system, the hardened cylinder liner is clamped into position and a machine cycle initiated manually. Four electrodes are automatically fed into the work by a servo system. The drilling electrode on each servo head is a brass tube with a profile the exact shape of the orifice to be machined.

ELECTION of **Paul M. Platzman** as vice president of sales and manufacturing for Acoustica Associates Inc. has been announced. The firm is a leading manufacturer of ultrasonic equipment, instruments and processing systems for the atomic energy, metalworking, electronic, automotive and other essential industries. It has also been announced that **Harold P. Baker** has been appointed vice president and treasurer, and **Ralph Reynolds** as technical sales manager.

Plastic Tubing With Zipper Makes Unique Harness Assembly

LACING and tying of electrical harness assemblies can be a time-consuming and expensive job. To offset these disadvantages, W. A. Plummer Mfg. Co., Los Angeles, has developed a new zipper style plastic tubing which is used to enclose, identify and protect multiconductor wiring in the aircraft, electronic or electrical applications. The ease with which wiring can be encased within the tubing suggests many applications in addition to the primary use as a substitute method for lacing and tying. Examples would be its use as wiring ducts, in short lengths as wire markers, and as a replaceable cable jacket to protect expensive custom cables from undue wear. Custom cabling for experimental use can also be made up quickly, avoiding prohibitive factory setup costs.

The zipper pull-tab used to close the tubing is detachable, and the tubing may be unzipped and reused or permanently sealed with a special sealer. When sealed, the tubing will withstand a linear strength test of 30 psi. Wires enclosed in the tubing remain flexible and are not as difficult to handle as with laced and tied cable assemblies. The technique has been approved by the Air Force for government use.

Triple Control Thyratron

OPERATING on the principle of ion deflection, a new coincidence thyratron can be used in circuits where the coincidence of two or three signals should fire the tube. Designated the KP-80, the new thyratron can be applied in computers, automation control apparatus, coding or programing devices, counters, etc., or wherever a coincidence function is to be performed.

Since the tube operates upon receipt of three signals, it eliminates the need for components presently required in circuits because only double coincidence can be performed by existing tubes. This reduction saves time and labor required in assembly operations, reduces cost, and results in increased equipment reliability. The tube is manufactured by Kip Electronics Corp., Stamford, Conn.

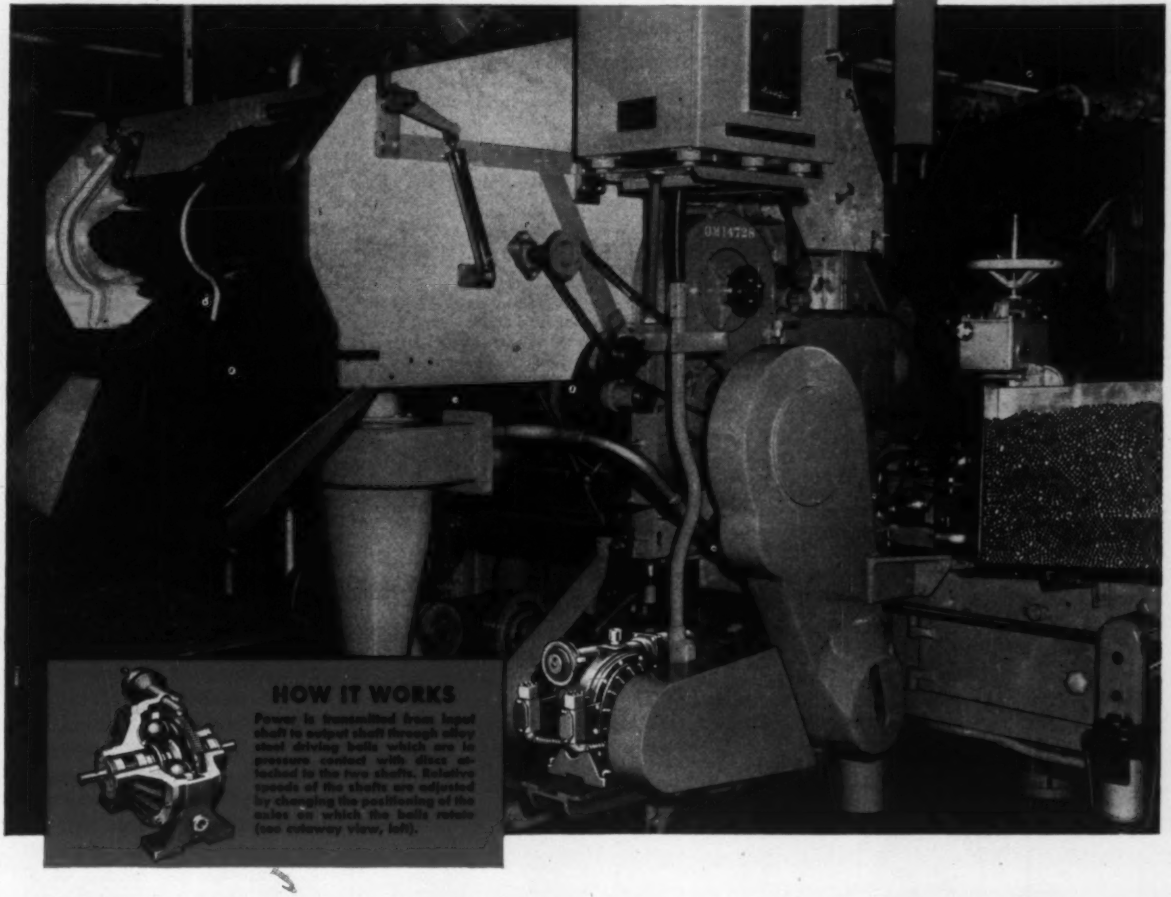
ALL PRODUCTION of the Thayer Scale & Engineering Corp. has been moved to their new plant at N. Pembroke, Mass. The new plant houses complete engineering and manufacturing facilities, tripling production capacity.

Southwest Products Co. reports a new address as a result of the annexation of that part of Duarte in which their factory is located. The new address is 1705 S. Mountain Ave., Monrovia, Calif.

An east coast distribution center has been established by the Reliance Electric & Engineering Co. In the new center at Elizabeth, N. J. Reliance motors, gear motors, VS drives, Reeves drives and their components will be assembled and

AccuRay electronic brain gets muscle power from Cleveland Speed Variator

The electronic control mechanism of this cigarette machine, known as the AccuRay cigarette gage controller, built by Industrial Nucleonics Corp., Columbus, Ohio, employs Cleveland Speed Variator size 4K4, driven at 1200 rpm input.



HOW IT WORKS

Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts. Relative speeds of the shafts are adjusted by changing the positioning of the axles on which the balls rotate (see cutaway view, left).

NATIONALLY famous for checking and controlling the making of Chesterfield cigarettes, AccuRay depends on a Cleveland Speed Variator for the delicate job of adjusting the tobacco feed rate in response to impulses from the gaging mechanism.

Being infinitely variable, the Cleveland Speed Variator gives stepless speeds over a full 9:1 range—from ⅓ to 3 times input speed. Output speed on this application is adjusted automatically by a regulating motor mounted on the Variator—but could be regulated manually or by remote controls of other types.

Available in eighteen standard types and sizes, the Cleveland Speed Variator offers these major advantages: 1. An extremely compact unit with input and output shafts in line and rotating in the same direction; 2. Almost any input speed up to 1800 rpm can be used—either clockwise or counterclockwise rotation; 3. Rated for constant horsepower output over a 9:1 range, or for constant output torque with a 6:1 range; 4. Infinitely variable over the entire speed range; 5. Rapid response to speed change, precise adjustment, and accurate maintenance of speed settings; 6. Long life and minimum maintenance due to absence of belts or complicated linkages; 7. Ample bearing support for overhung pulleys on either input or output shafts.

Write for Bulletin K-200 for detailed description with photographs, sectional drawings, rating tables and specifications.

THE CLEVELAND WORM AND GEAR COMPANY

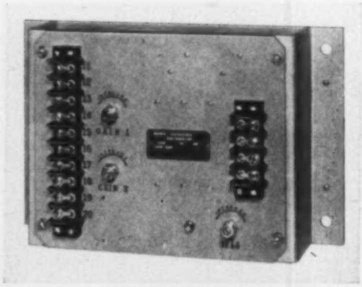
Speed Variator Division, 3265 East 80th Street, Cleveland 4, Ohio

Sales Representatives in all major industrial markets • In Canada—Peacock Brothers Limited

Circle 559 on Inquiry Card

warehoused.

A merger between Midwestern Instruments Inc., Tulsa, and Magnecord Inc., Chicago, has been announced. Magnecord will operate as a division of Midwestern Instruments. The latter company is a leading manufacturer of oscillographs, galvanometers, torque motors and other industrial electronic equipment. Magnecord is noted largely for its professional and industrial magnetic tape recording equipment.



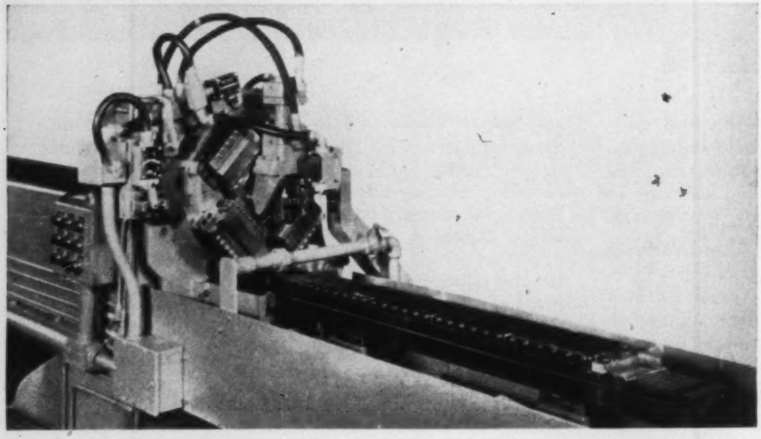
TRANSISTORIZED servoamplifier and new electrohydraulic three-way servovalve have been developed by Minneapolis-Honeywell Regulator Co. for use in electrohydraulic control of industrial machinery. The amplifier is designed to receive signal inputs from any standard 60-cycle ac signal source. The user can provide manually variable control, can make the control source a function of position, velocity or other command variable, or can utilize input signals from tracers or computers. Linear motion control can be applied to hydraulic presses, reciprocating drives used in planers, grinders, and in a wide variety of straight line positioning applications. Rotary motion applications include lead screw feeds, spindle drives, and process machinery which requires precise control of shaft rotation.

Molded Resin Circuit Panel

NEW TYPE of circuit panel, molded of a variety of resins, eliminates the need for piercing dies and punch presses in panel manufacture. The new circuit panel has been developed by Die Form Circuits Inc., Cicero, Ill. Circuit configuration and holes are molded into the panel, and circuits are depressed below the outer surface secure from physical damage and free from circuit shorts due to component enclosures resting on the panel surface. The technique of fabricating a printed circuit in this manner out of an electrical grade phenol resin provides a completely cured panel that will not soften under the higher temperatures necessary in soldering. The panel can be provided with circuits on one or both sides as desired, and requires but two weeks' engineering to bring into production.

Relatively large hour - glass shaped holes allow automatic insertion entirely free of jamming prevalent in paper laminate caused by misalignment of holes occurring because of shrinkage of the laminate after heating prior to piercing. The conductors and hole linings are entirely of copper with electroplated solder applied to the entire circuit to prevent copper oxidation.

The hour-glass shaped copper lined holes are completely filled after soldering, securely imbedding the component terminals. Accordingly, no component terminals need to be crimped either for holding or to effect soldering. The elimination of crimping will allow manual insertion of parts by operators at an assembly machine if wanted, and therefore permits complete assembly by any combination of manual and automatic means.



EIGHT-POSITION indexing fixture on horizontal broaching machine, manually loaded and automatically unloaded, enables a lock manufacturer to turn out brass lock cylinders at the rate of 1250 per hour. The eight-position rotary fixture consists of four workholding stations each capable of holding five cylinders and four broach return positions; every other index brings a new group of five lock cylinders into broaching position. Cylinders varying in length from ⅝ to 2 inches and having 0.402 or 0.451-inch diameters are handled by the fixture with only minor changes in the tooling. Equipment is built by the Colonial Broach & Machine Co.

Continuous Gas Analysis

DEPENDABLE analysis of industrial gas streams is possible with new process gas chromatograph recently introduced by Beckman Instruments Inc. The device permits continuous sampling of any gaseous process stream. Each sample is automatically passed through a packed column of absorbent material. Gases, which have been separated into their component parts by the chromatographic column of absorbent material, are washed out of the column by a stream of helium. In successive order, the individual components are passed through a thermal conductivity cell which determines both the amount and type of compound present. Precisely timed sampling values can be set to analyze up to eight components of a single plant stream, or from two to seven different plant streams of similar composition. Once set, the operation of the instrument is completely automatic.

According to **John F. Bishop,** general manager of the Scientific Instruments Div. of Beckman Instruments, the information can be fed into a relatively simple control system which can keep track of the process and automatically correct any deviations. The new instrument is similar to analytical instruments used in the laboratory, with the important difference that it has the trouble-free, continuous action characteristics necessary for use in process line situations.

WANTED

Technical Editor

Here is a real challenge for the right man with enthusiasm for writing and a strong creative urge to broaden his perspective and assist industry in effectively applying the techniques of automation.

Edited by a competent staff of experienced engineers, AUTOMATION has an opening for an engineer with diversified manufacturing or production equipment design background and editorial or other writing experience. He should be able to write well, be familiar with automation engineering and have evidence of same.

Duties include development, writing, editing articles and feature departments.

There will be opportunity to travel on editorial assignments and attend meetings, expositions, etc.

Headquarters in Cleveland, Ohio.

If you are interested and feel qualified, please send full details of your practical engineering and writing experience to the Editor, AUTOMATION, Penton Building, Cleveland 13, Ohio.

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Job-Rated for the Particular Load to Give Maximum Performance on Your Job

NON-LUBRICATED EASILY-ASSEMBLED **FLEXIBLE COUPLINGS**

Bores (max.) . . . . . 5/16" to 9½"
O.D. . . . . 5/8" to 21½"
Wt. . . . . . . ½ oz. to 1500 lb.
H.P. . . . . 1/20 to 3000
Torque (static) . . 1½ to 5100 ft.-lbs.

MAINTENANCE-FREE INSTANTLY-ADJUSTABLE **VARIABLE SPEED PULLEYS**

Bores (max.) . . . . . ½" to 1⅝"
O.D. . . . . 3" to 13⅝"
Belt Sizes . . . . A to 2¾ TW
Speed Ratios . . . . . . 1-1 to 8-1
H.P. (1750 rpm.) . . . . ¼ to 15

ECONOMICALLY-PRICED INFINITELY-VARIABLE **SELECT-O-SPEED TRANSMISSIONS**

Controls . Lever or Hand Wheel
Belt Sizes . . . . A to C
Speed Ratios . . . . . 1-1 to 10-1
H.P. (1750 rpm.) . . . ⅓ to 7½

LIGHT-WEIGHT PRECISION-BUILT **UNIVERSAL JOINTS**

Bores . . . . ¼" to 2"
Hub Dia. . . . . ½" to 4"
Static Torque 340 to 130700 in.-lbs.
H.P. (100 rpm.) . . . . . ½ to 207

Get Lovejoy performance for your equipment.
Request full information now.

LOVEJOY FLEXIBLE COUPLING CO.
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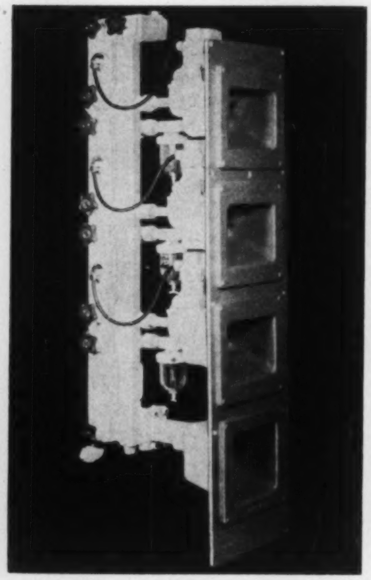

INCREASED use of auxiliary equipment with power presses has led Clearing Machine Corp. to develop compact air manifold to replace elaborate network of piping and fittings normally found on presses. Manifold requires only air inlet and exhaust connections for setup. A single unit contains necessary solenoid controls, lubricators and air circuits suitable for such auxiliary equipment as coil feeders, unloaders, die lifters, stock dopers, and other devices. Exhaust from normal operation of the solenoid valves is directed to a single port at the bottom of the manifold and can be piped to an air silencer located away from the control compartment. Solenoid units are easily detached for servicing.

Water Base Hydraulic Fluids Prove Value To Industry

LABORATORY tests and actual industrial service over a two-year period have proved the characteristics of two new fire-resistant hydrolube fluids, developed by Carbide & Carbon Chemicals Co., a Division of Union Carbide and Carbon Corp. Wear resistance of the hydrolubes is improved and is in the same general range as petroleum hydraulic oils. Tests have shown improved vapor phase corrosion protection for ferrous metals over that of previous formulations.

Hydrolube fire-resistant hydraulic fluids are now widely used in applications where petroleum oils would present a fire hazard. Many serious fires have occurred when flammable petroleum oils from ruptured hydraulic lines have been

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426	456	486	516	546	576	606	636	666
427	457	487	517	547	577	607	637	667
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429	459	489	519	549	579	609	639	669
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For your convenience, advertisements and items of information on new equipment, components and manufacturers literature now can be quickly identified by an *Item Number* printed just below each unit.

For additional free information circle item number on an inquiry card. Fill in your name, title, address, etc.—Drop it in the mail—No Postage Required—Your request will receive prompt attention and will be filled directly by the manufacturer.

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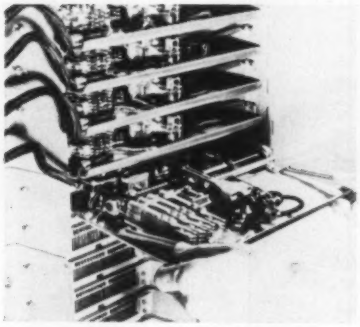
Keep Up-to-Date!

ignited by sparks, hot surfaces, or flame. With water base hydraulic fluids, this hazard is minimized since they are essentially nonflammable as long as the recommended water content is maintained.



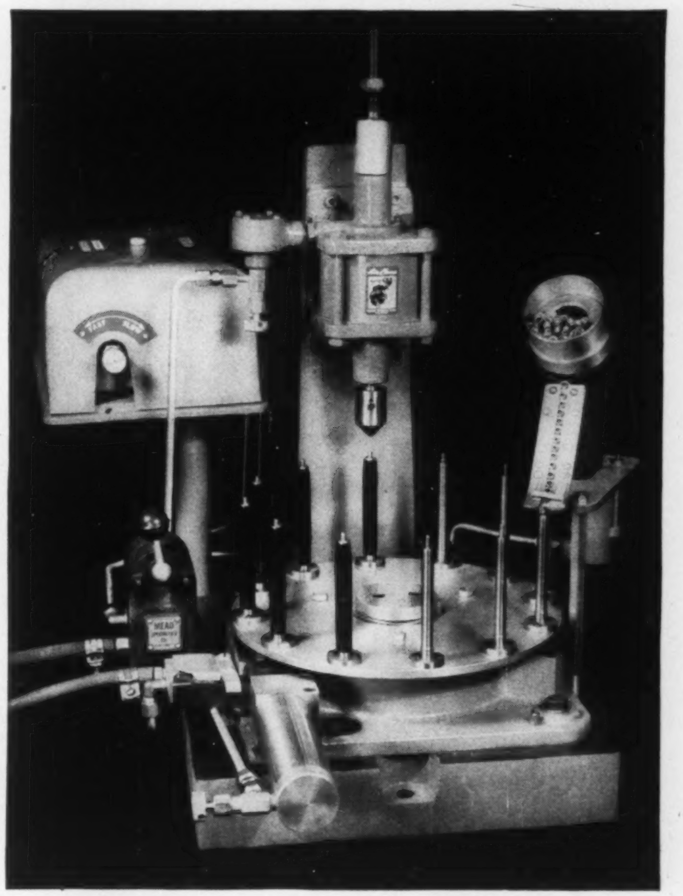
ELECTROMECHANICAL switches originally designed for telephone systems are now being offered to industrial users by Stromberg-Carlson, Div. of General Dynamics Corp. Units include the illustrated *XY* universal switch which can be easily and quickly inserted in or removed from its mounting cell. Switch operating through ten points in each of two directions can select and make contact with any one of 100 four-wire circuits, can select an idle circuit from such a group, or can be used to sequence through the 100 circuits, as for testing purposes.

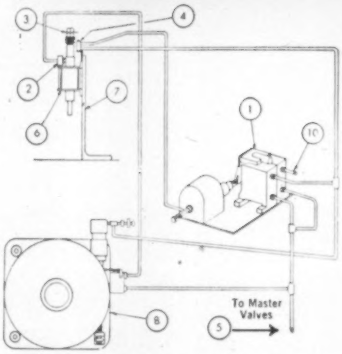
Window Channel Production

VOLUME producer of automotive window channel and weatherstrip, the Standard Products Co. has expanded its West Coast facilities. **J. S. Reid,** president of the company, has described the continuous flow window channel and weatherstrip production line in the new plant as the most modern and automatic window channel line in the world. The operation begins with a coil of steel tape which is perforated and to which rubber and cloth are added. The tape then is slit and formed with beading attached, in a single integrated operation. The result is a window channel and weatherstrip that keeps automobiles free of dirt, dust, etc. The new line will produce channel at a rate of 1,800,000 ft a month—or 4000 miles a year.

In addition to window channel and weatherstrip, principal products of the new plant include automotive grills, other automotive hardware and trim, aluminum and steel stampings and rolled sections, anodized parts, and automobile

Automation With Air Power

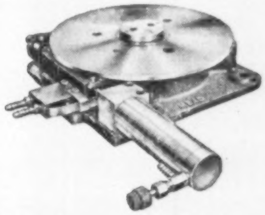




Circuit Diagram of Units in This Photo

Combine readily to feed work to drill press, air impact hammer for a wide variety of operations.

MEAD Rotary Work Feeder is the heart of this machine to crimp eyelets and rings on pen barrels. A simple combination of standard Mead units makes a semi-automatic machine—operator merely loads.



The ROTARY WORK FEEDER Indexes to 8, 12 or 24 stations, at speeds from 15 to 150 stations per minute. Auxiliary valve actuates drill press feed or other pneumatic tool as each station indexes.

(1) Meadmatic Timer controls cycles per minute and "dwell". (2) Speed control valve and quick exhaust valve regulate advance and retraction of tool. (3) Adjustable depth stop. (6) Single-acting air cylinder. (7) Vertical stand. (8) Rotary Work Feeder. All units mounted on Universal Base.

MEAD

Write for free booklet of 44 "Examples in Air Power Automation".

SPECIALTIES COMPANY, 4114 N. Knox, Dept. A-17, Chicago 41, Ill.

PATHFINDER IN AIR POWER AUTOMATION

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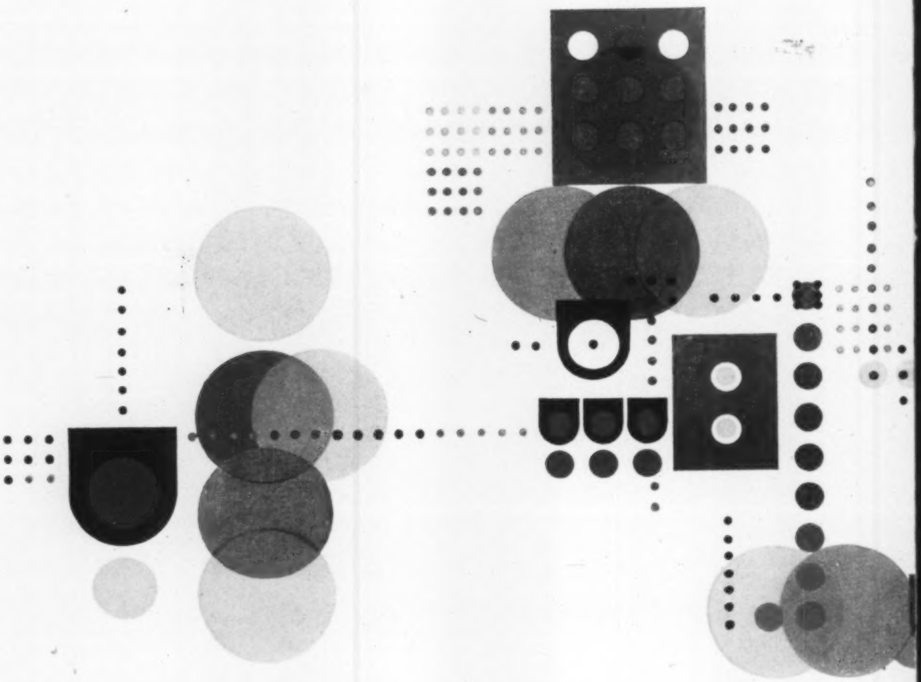
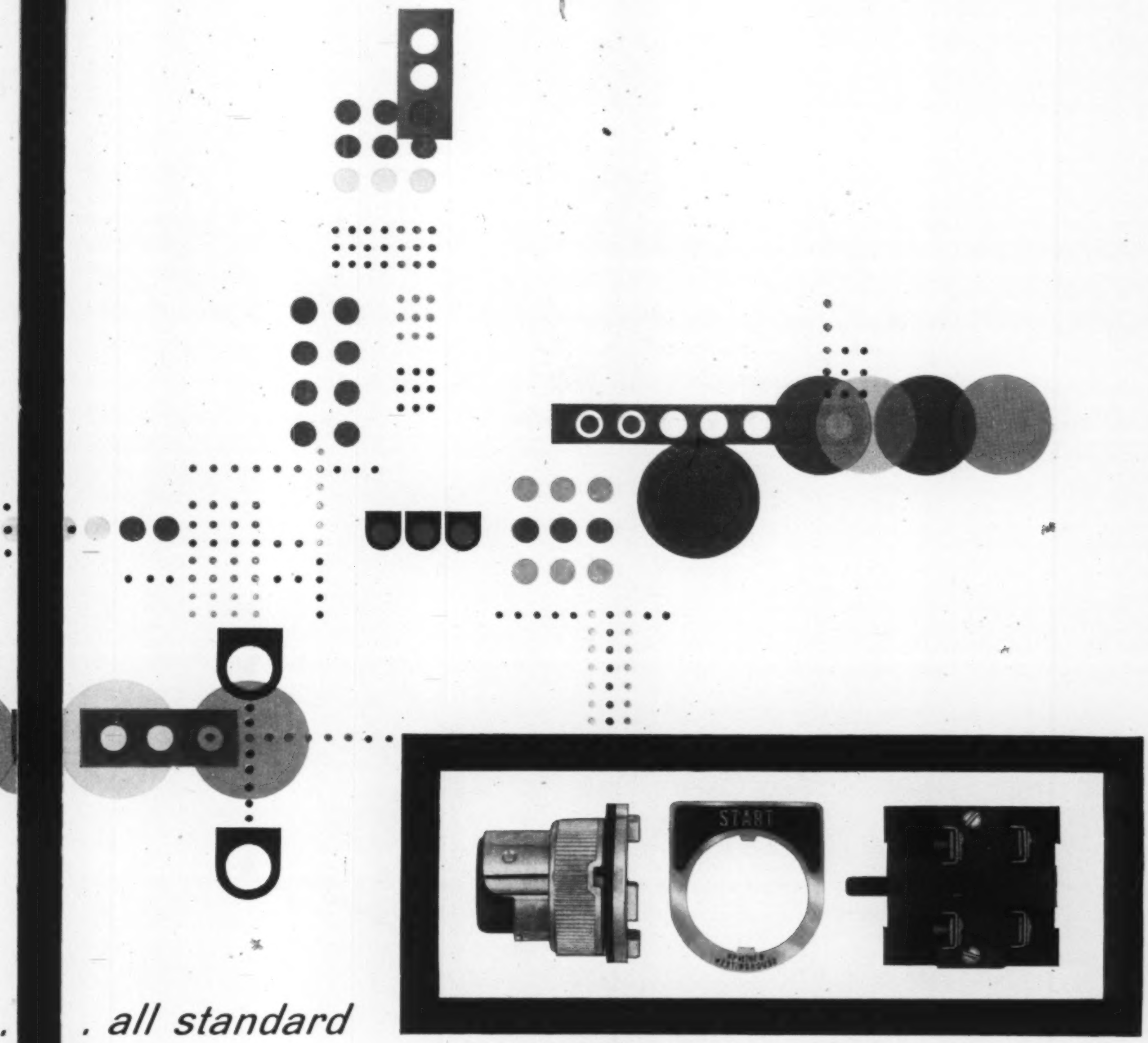
Next Page Circle 563→



Pushbutton control arrangements almost to infinity .



How'd you like a stock of 1,500,000 pushbutton controls on hand at all times for original equipment needs or for production purposes?

Sound prohibitive space-wise, or too expensive? Not at all. Just 38 Westinghouse components (shown above) do it because all parts are standardized and interchangeable. And always available from stock.

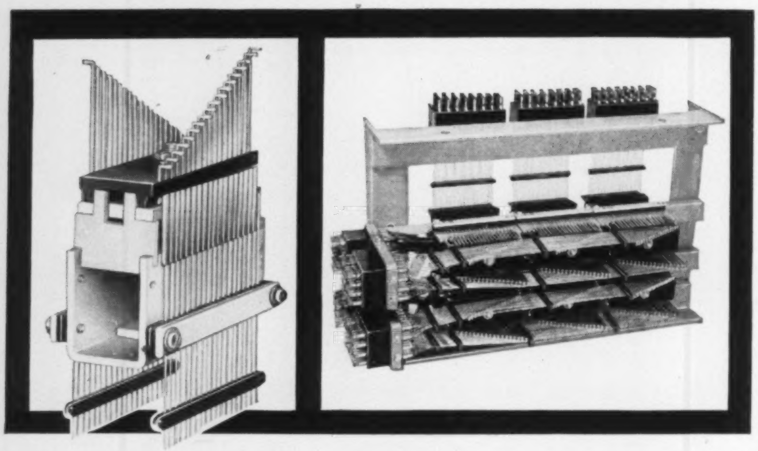
If you need controls for any application, write for the free 72-page *Pushbutton Guide,* B-6749. For control where moisture is a problem, write for free Booklet, B-7022, about Oil-Tite* controls. Write to Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa. Or call your Westinghouse Distributor.

*T. M.

J-30248

YOU CAN BE SURE...IF IT'S

Westinghouse



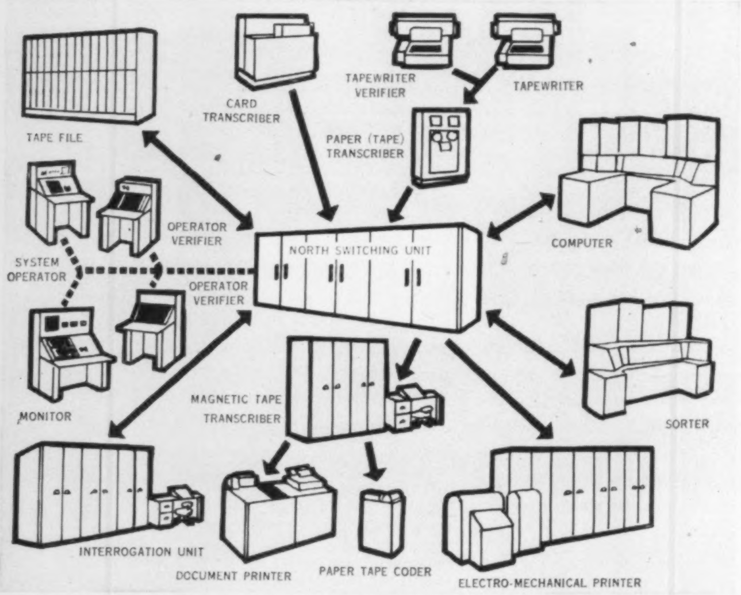
OPENING NEW HORIZONS
IN DATA PROCESSING SYSTEM DESIGN

The requirements for a switching system that will handle the high information rates of input and output devices in data processing systems have been so demanding that, until now, they have constituted a serious barrier to data processing system design.

The New NORTH REED ARMATURE RELAY handles these switching chores with maximum efficiency and minimum crosstalk, opening new horizons in system design.

NORTH REED ARMATURE MATRIX SWITCHES *are being used successfully today* in "NORTH designed and built" system centrals in high speed data processing systems.

Write for complete details on how the new NORTH REED ARMATURE RELAY can provide an important link in data processing systems.



"BUILDING 'BRAINS' IS OUR BUSINESS"
INDUSTRIAL DIVISION Trademark
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NORTH ELECTRIC COMPANY
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vent windows. The plant will employ 56 men and women initially, and employment is expected to increase to 190 within six months.

WIDELY SCATTERED parts of Baldwin - Lima - Hamilton Corp.'s newest division have been consolidated in a new plant at Waltham, Mass. The Electronics & Instrumentation Div.—which manufactures testing instruments, SR-4 strain gages, testing systems, testing machines and allied equipment—previously functioned as Ruge de Forest Inc., O. S. Peters Co., Sonntag Scientific Co., and the Testing Equipment Dept. of the Eddystone Div. of Baldwin-Lima-Hamilton. The new division, which will have a production capacity one-third greater than the combined capacities of the companies brought together to form it, will have an initial output product of $700,000 per month.

Utilization of Abilities Determines Worker Contentment

WITH automation, giving a man more responsibility may make his job more interesting, but not necessarily more satisfying. This conclusion was reached as a result of a University of Michigan study of a comparison of employee attitudes in two electric power plants. The survey was made by **Richard Hoffman** and **Floyd Mann** of the University of Michigan Survey Research Center.

Their study found that automation offers management an unusual opportunity to redesign and enlarge each job to make greater use of employee skills—a key factor in improving job satisfaction of employees. However, the responsibility is a two-edged sword. Merely increasing job responsibility may be in fact a detriment to job satisfaction. When management plans job changes as a result of automation, it should focus its attention on changing job content to use more of the employee's skills rather than altering more peripheral aspects of the work situation. For instance, the fact that automation may give workers greater mobility and more frequent contact with fellow workers

Which will it be —?

Price

Cost

As you well know, *price* of new equipment is only the beginning. Actual production savings determine real equipment *cost.*

From this realistic *cost* standpoint you can't beat Erickson collet chucks. Here's why:

Guaranteed accuracy of .0005" and superior gripping power of Erickson collet chucks assure proper drill alignment. Drills then cut evenly on both cutting lips permitting faster machine feeds and proper speeds . . . give more holes per grind.

What's more, ease of operation greatly reduces set-up time and since Erickson chucks can grip on the flutes, you can stub your drills . . . extend tool life . . . maintain accuracy.

Send for new Catalog K today! It gives the complete Erickson story. You'll find many interesting applications for all Erickson holding tools.

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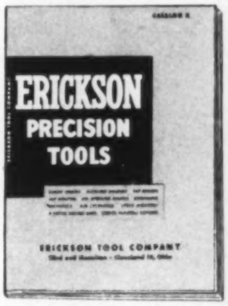

CATALOG K

ERICKSON

PRECISION

TOOLS

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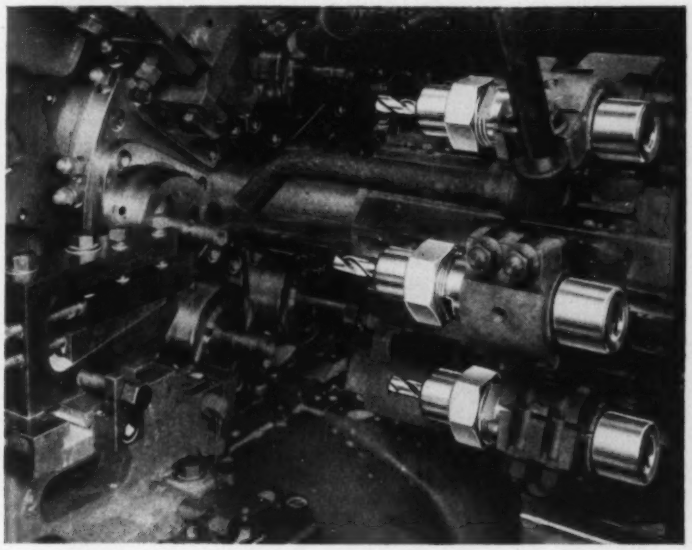

ERICKSON Holding Tools

.0005

Guaranteed Accuracy

COLLET CHUCKS • FLOATING HOLDERS

TAP CHUCKS • TAP HOLDERS • AIR-OPERATED

CHUCKS • EXPANDING MANDRELS • SPECIAL HOLDING FIXTURES

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does not have any significant relation to increased interest or satisfaction from the redefined job. Workers attach importance to being able to express themselves through their jobs. The feeling that the job they do eight hours a day requires the use of their best knowledge and abilities appears to make them more satisfied with their work. Jobs in automated plants designed to utilize the potential of the worker as a human being rather than as a mechanical robot help restore some of the intrinsic job satisfactions which have been taken from him over the years.

The study covered two comparable power generating plants, one built on conventional lines and the other incorporating recent engineering devices resulting in a highly automated plant.

PLANS have been announced by the General Electric Co. for the establishment of the headquarters of its Computer Dept. at Phoenix, Ariz. **H. R. Oldfield Jr.,** general manager of the department, said the move would involve initially the establishment of administrative, engineering and research facilities. Temporary headquarters for the Computer Dept. have been in Syracuse, N. Y. The move to Phoenix will not affect the company's Syracuse operations, since no large-scale production of computers has started.

According to Oldfield, the new computer operation at Phoenix will develop a line of computers designed for business and industrial use. The department will not at this time build or market the type of computer aimed particularly at scientific use, but instead, will develop computer systems tailored to the specific requirements of its customers. The first such product to be delivered will be the ERMA system for the Bank of America, a computer system designed to perform daily bookkeeping tasks for the entire Bank of America chain of branches.

MEETINGS AND EVENTS

Jan. 14-16—
Third National Symposium on Reliability and Quality Control in Electronics. To be held Hotel Statler, Washington, D.C. Additional information may be obtained from R. C. Murrell, Melpar Inc., Falls Church, Va.

Jan. 14-18—
Society of Automotive Engineers. Annual meeting and engineering display to be held Sheraton-Cadillac and Statler hotels, Detroit. Additional information may be obtained from society headquarters, 29 W. 39th St., New York 18, N.Y.

Jan. 21-25—
American Institute of Electrical Engineers. Winter general meeting to be held Hotel Statler, New York City. Additional information may be obtained from Institute headquarters, 33 W. 39th St., New York 18, N.Y.

Jan. 24-25—
The Franklin Institute. Digital computer symposium, with theme "Automatic Coding," to be held at Institute's Lecture Hall, Philadelphia. Additional information may be obtained from the Institute, 20th and Parkway, Philadelphia 3, Pa.

Jan. 28-31—
Plant Maintenance and Engineering Show. To be held Public Auditorium, Cleveland. Additional information may be obtained from Clapp & Poliak Inc., 341 Madison Ave., New York 17, N.Y.

Feb. 19 —
Rochester Society for Quality Control. 13th Annual Quality Control Clinic to be held War Memorial, Rochester, N.Y. Additional information may be obtained from T. J. Soebbing, Eastman Kodak Co., Navy Ordnance Div., 50 Main St. W., Rochester 14, N.Y.

Feb. 26-28—
Western Joint Computer Conference. Jointly sponsored by IRE, AIEE and ACM, conference theme is "Techniques for Reliability." To be held Hotel Statler, Los Angeles. Additional information may be obtained from S. D. Wanlass, 13729 Victory Blvd., Van Nuys, Calif.

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AUTOMATION

"Ingleby is one of our best designers . . . has an intuitive ability."

Mar. 10-16—
International Atomic Exposition. With Nuclear Engineering and Science Congress to be held Convention Hall, Philadelphia. Additional information may be obtained from American Institute of Chemical Engineers, 25 W. 45th St., New York 36, N.Y.

Mar. 18-21—
The Society of the Plastics Industry Inc. National conference and Pacific Coast Exposition to be held Shrine Exposition Hall, Los Angeles. Additional information may be obtained from society headquarters, 250 Park Ave., New York 17, N.Y.

Mar. 18-21—
Institute of Radio Engineers. National Convention and exposition to be held Hotel Waldorf-Astoria and N.Y. Coliseum, New York City. Additional information may be obtained from society headquarters, One E. 79th St., New York, N.Y.

Mar. 25-29—
Western Metal Show. To be held Pan-Pacific Auditorium, Los Angeles. Additional information may be obtained from American Society for Metals, 7301 Euclid Ave., Cleveland 3, O.

SHOCK ABSORBER...

NODULAR GRAPHITE IRON CONSTRUCTION protects exposed motors

● In shops, aboard ship or in quarries . . . anywhere that a motor is exposed to shock or direct impact, Peerless Motor nodular graphite iron construction does a better job. End shells and frames are nodular construction. They absorb tremendous impact without cracking or distortion. Nodular construction by Peerless gives you a motor housing with all of the advantages of cast steel, but it costs less.

During impact tests the bolts holding the motor to the test stand were sheared by the impact used. The motor bounced free of the test bench, across a 20-foot floor, hit the opposite wall and came to rest STILL OPERATING! The motor checked out perfectly in all subsequent tests.

If you have an application that exposes the motor to moving vehicles, falling rock, steel or debris, it will pay you to consult the Peerless engineers about building it of nodular iron. They'll work with you to develop the one motor that powers your product best. A letter or phone call to Peerless will bring immediate action.

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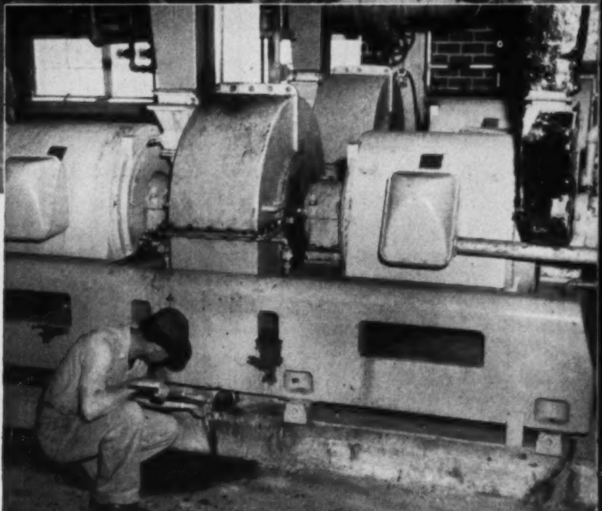
One in a series
on the application
of electric motors
in modern industry

This washer removes fly ash from cars left in the parking lot. The 25 hp. Reliance A-c. Motor automatically starts and stops 200 to 400 times a day in all kinds of weather.



These two Bauer Refiners are driven by Reliance 400 hp. A-c. Motors. The grinding action of the machines sets up heavy load factors on the motors.

RELIANCE motor design proved in new paper mill

Here is a 100 hp. Reliance Totally-Protected A-c. Motor doing a job under very adverse conditions. The water and pulp being sprayed on it is coming from a paper board machine, part of an installation that Crossett Paper Company recently built to produce bleached kraft board from hardwood and pine pulp.

But there is more to a Reliance Motor than just a good enclosure. Extra copper and iron, the best bearing lubrication system, tough, resistant insulation . . . these and many more features add up to designed durability, the one big feature that makes users, like Crossett, steady Reliance customers.

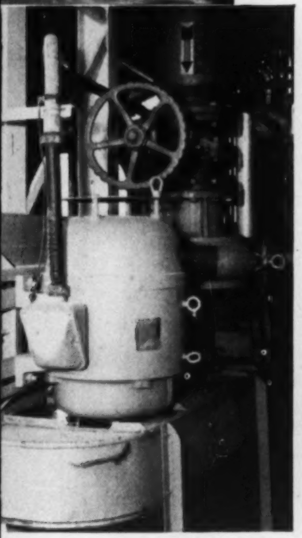
Call your Reliance representative and ask him to show you the Reliance extras. Fifteen minutes of your time now can save hours of machine downtime later.

For further details on this installation, write for bulletin B-2504. B-1536

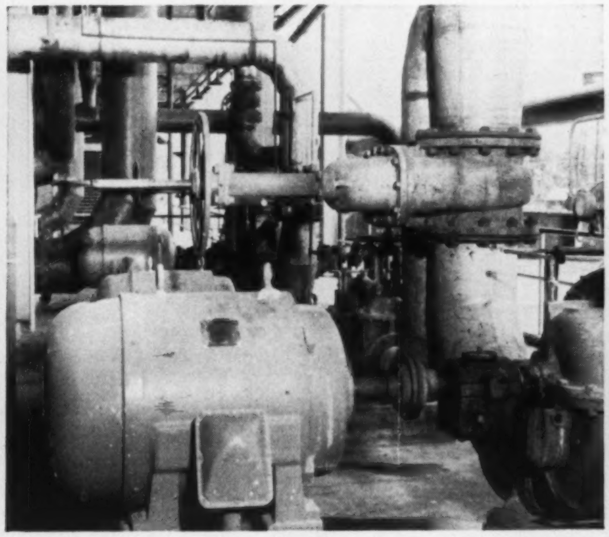
RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 261A, CLEVELAND 10, OHIO • CANADIAN DIVISION: WELLAND, ONTARIO
Sales Offices and Distributors in Principal Cities

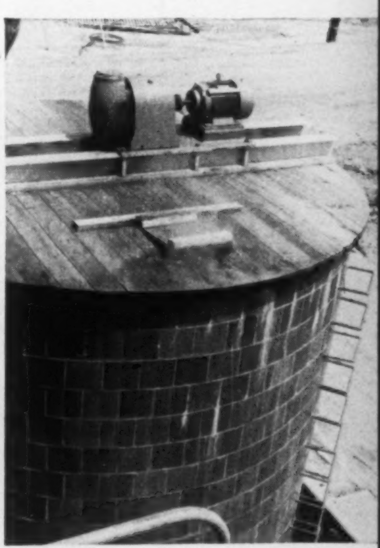
◀ Located under the head end of the board machine, this 100 hp. Reliance A-c. Motor operates a fan pump while periodically being drenched with water and pulp.



Reliance has frame designs for every application. Here is a 25 hp. foot mounted vertical motor driving a refined-stock pump. Other vertical designs include C-Face, D-Flange, and P-Base mountings.



This 60 hp., 1800 rpm and two 40 hp. 900 rpm Reliance A-c. Motors run white water pumps. Though reasonably sheltered from the elements, the motors are subjected to wide temperature changes.



In hard to reach spots like this two story high refined stock chest, Metermatic Bearing lubrication is very important. This new line 20 hp. Reliance A-c. Motor will operate the agitator for months without greasing.

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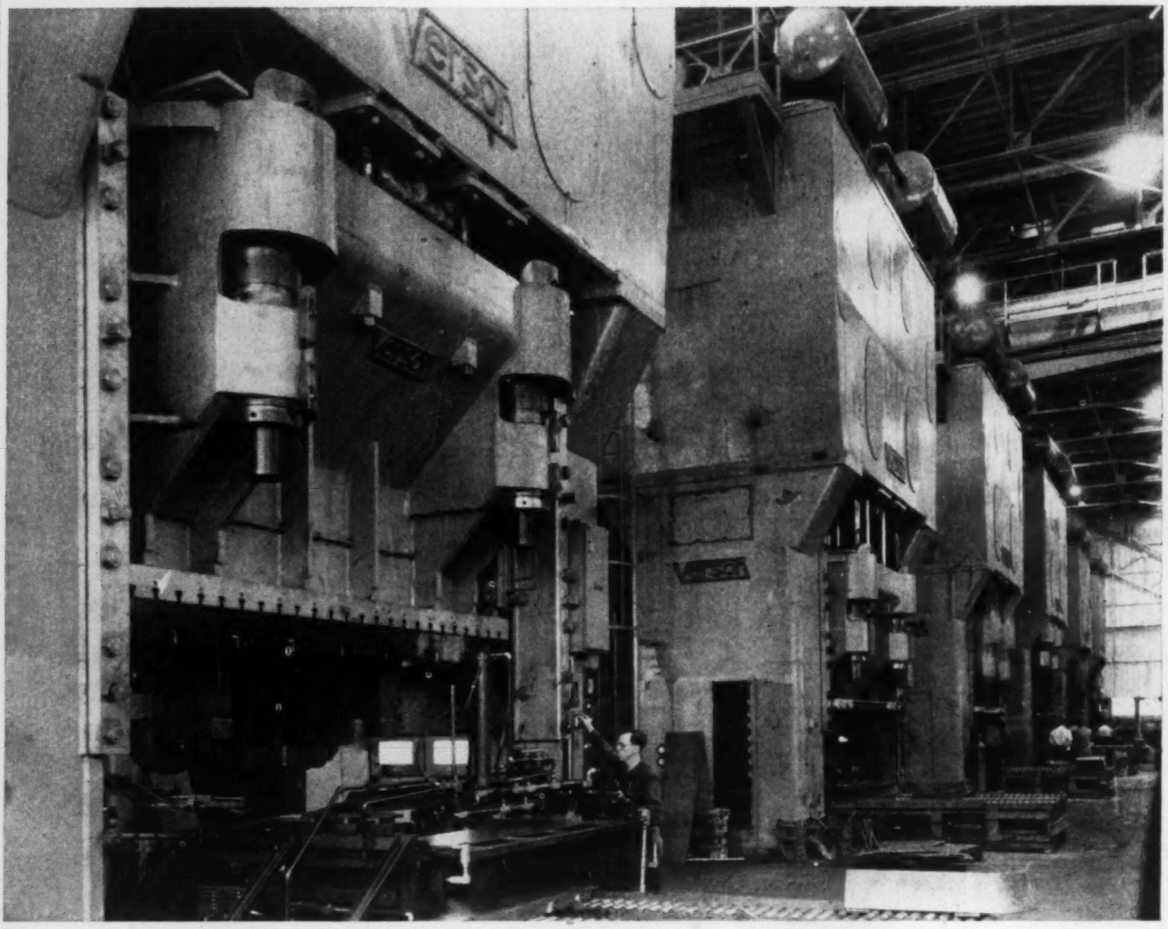

Could you compete with a press room like this?

the RISING COST of Obsolescence

Obsolescence is the creeping malignancy of manufacturing. The longer it goes unchecked, the weaker its victim becomes, the more costly the cure. Recent developments by Verson in the press forming of metals have obsoleted processes that were the most efficient available a few short years ago. Check your plant for symptoms.

Unless you're in the automotive industry you probably won't have to compete with this particular press room. But, if you make anything that is pressed out of metal you probably will have to compete with a press room equally modern and efficient.

What does this mean to you?

Competition that reaches its culmination in the market place often begins in the shop. Here is where a large measure of your competitive price position is determined. Here is where profits can be made—or lost.

What's the answer?

The answer is a *planned* program of modernization of your production processes. Sit down with your suppliers and develop a program for systematically replacing inefficient, obsolete methods. Generally, you need not replace it all at once. Very often one machine at a time can be replaced, just so it is done to a well developed plan.

In your press room, sit down with Verson. Put Verson experience in the development of production processes to work for you. Utilize the know-how that results from Verson's approach to press building—"Anyone can build a press, Verson builds production processes". Write or phone.

A Verson Press for every job from 60 tons up.

TRADE **Verson** MARK

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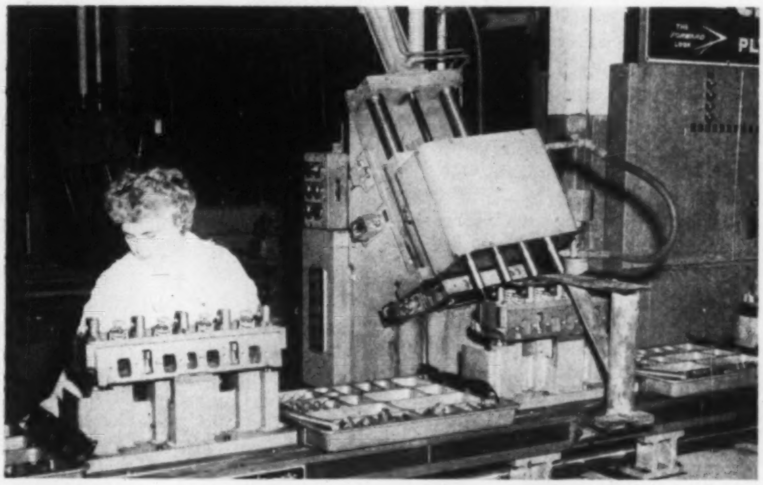
detroit dateline

By JAMES C. KEEBLER
Associate Editor



In Plymouth's Detroit engine plant automated stations of the assembly line perform side by side with manually operated stations. Here spark plugs are automatically torque-tightened. Small parts needed for each head move along the Cross machine in plastic trays into which they were automatically loaded.

Working Automation

AT THE TURN of the calendar from one year to the next it is customary for industrialists and journalists to step back and take a look at where we've been and where we're heading.

Will Rogers once spoofed such practice by calling attention to the annual splash of printed encouragement wherein he observed each industrial leader of note being quoted as saying in effect "I am at heart an optimist." What tickled his funnybone most about this situation was its unfailing regularity—whether times were good or bad. The renowned businessman has historically seen fit to encourage his countrymen about the prospects for a brighter future.

Looking Good

No rose colored glasses are needed by the auto industry spokesmen this year to look at 1956 and the prospects for 1957 and say something optimistic.

A look at some Ford figures shows what went on. R. S. McNamara, Ford Div. general manager revealed that development, tooling, and launching expenditures for the 1957 model jingled the nation's cash registers to a grand total of $209 million.

This does not include another $167 million earmarked for new plant facilities to produce parts. New model acceptance put the division's 15 car-assembly plants on heavy overtime schedules. On Nov. 28 Ford broke previous records by putting together more than 8500 cars and trucks in a single day.

Benson Ford is on the records with statements indicating they won't be surprised to see industry sales pass 7 million cars in '57 nor to find an 8.5 million new car annual volume become the norm by 1965, with occasional peaks of 9.5 to 10 million volume by that time.

Automation Is Working

So far as automation is concerned, one thing is certain—automation is working. One of the talks most enthusiastically received at the AUTOMATION-Purdue Conference on Manufacturing Automation held in October was that delivered by Chrysler's Harry R. Bentley, of the engine division. Conferees got a first-hand glimpse of the development from scratch of a large, highly automated plant.

Subject under discussion was the new Plymouth engine plant in Detroit. At this facility, designed to turn out at least 150 engines per hour, the normal working force is 3000. Bentley acknowledged this to be the industry's most highly automated engine plant and went on to explain that since no manufacturer in his right mind was going to automate just for the sake of automation, they had used basic economic decisions to determine which processes to automate and which could be done more efficiently by making full use of the human brain, hand and eye.

Comments that followed the formal presentation and informal discussion were to the effect that —boy those automakers really put automation to work—that fellow surely knows his automation—this talk carried considerable weight with me—there's real leadership in automation know-how.

Auto Leadership

Besides leadership in the technology of what Bentley defined as the "optimum use of machines to produce high-volume, high-quality products at the lowest possible cost" the auto industry has also taken the lead in the training of workers for new opportunities and responsibilities of a higher class of employment. With courses in hydraulics and electronics the maintenance men are being trained on company time to tend the newer types of equipment being installed.

With overall auto employment figures rising and better jobs being made available, it looks like automation is working for the workers too.

Recognition by Resolution

In its 1956 session the International Labor Conference in Geneva unanimously passed a resolution recognizing automation as "an effective means of providing expanding national economies, rising employment, and higher standards of living for the peoples of the world."

UAW's Walter P. Reuther has recognized that automation is providing the wherewithal from which the people of this country will gain even higher standards of living and looks forward to providing his members with a shorter work week and greater leisure.

So the year ended with the leaders of industry and unions in agreement that this idea of automation is not a bogeyman to create vast unemployment but instead it's working for the good.

Crystal Ball Work

To gaze into the future at the job ahead, so far as the technology of automation is concerned, it looks like the problem is to develop the art by building on the accomplishments thus far achieved. This is to advance the leadership already established.

But leaders do not only strengthen their strong points—they continually search out their weaknesses and accept them as the great challenges for future effort. In this light the auto industry can be expected to take a newer and stronger stand on automation at the factory worker level.

It is not enough that the leaders of labor understand the facts of automated life. The story must be taken to the people themselves. This is not only a labor relations job but assumes the proportions of a full-scale public relations program.

Often in the past the foremen, management's front line on the factory floor, has been stuck in the middle with the job of selling automation both ways. Justifying to the man upstairs his need for automatic equipment, and justifying to the man on the machine that the net result is not bread lines.

Worthwhile Advancement

Example can be taken from the educational efforts of General Electric, whose film "This Is Automation" is supplemented by TV commercials and employee meetings in an excellent effort to take the story to the people.

The goal is to give the worker the knowledge that he and his company are participating in worthwhile advancement. Psychologists have long since observed that neither of two men genuinely concerned with a given effort are likely to scuttle it. If a man is in the boat with you he's not likely to bore a hole in it.

With such efforts to back them up the automakers will not have cause to fear that when a labor leader says this is good, he might mean it's a good club with which to clobber the management.

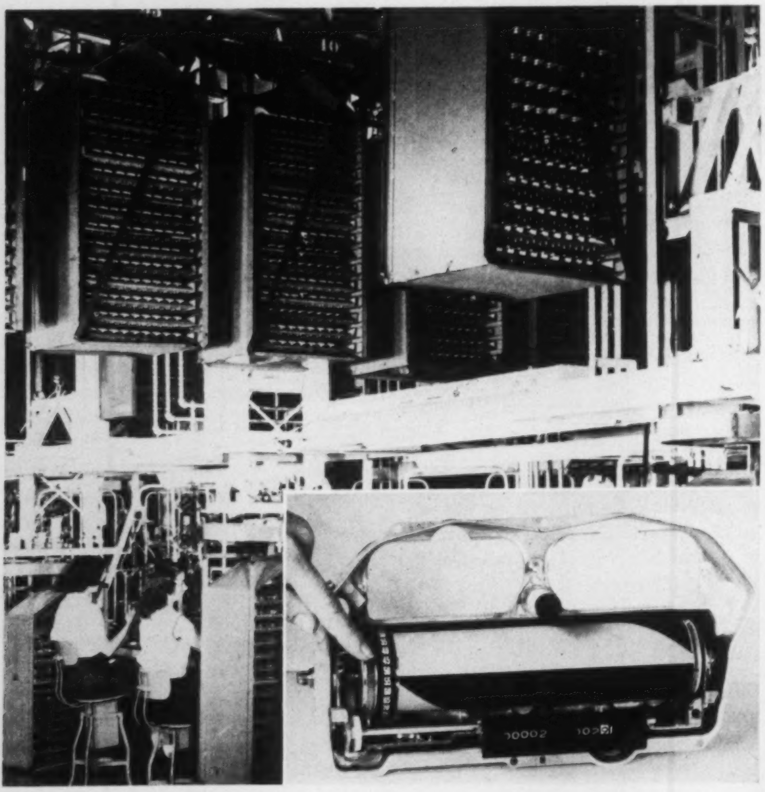
Full of Fuel

There's no scarcity of auto industry examples of the benefits of increased automation. The plants of Detroit are loaded with stories to be told. The time is ripe for telling. Not only is the potential unit market expanding but the buyer is offered and requesting a more complex auto.

AC Spark Plug's development of the "Safety-Minder" that can be set to sound a warning signal when the speedometer reaches any speed the motorist chooses is an example of new equipment being manufactured in 1957 that was not available in years gone by.

Automatic features on cars are in higher demand: On the 1954 & 5 models 65 per cent had automatic transmissions, 28 per cent power brakes and 22 per cent power steering—comparable figures for 1948 & 9 were 20, 4 and 1.

With increased markets for more complicated machines there's every reason why automaters, automakers, and autoworkers should look to 1957 as a good year to come with the suggested theme song: "We've Come a Long Way Together—But We Still Have a Long Way To Go."



Insert shows inside of a 1957 Buick speedometer which incorporates the "Safety-Minder" developed by AC Spark Plug Div. to automatically warn the driver if his car exceeds a preselected speed. Production lines for such speedometers are automatically supplied with component subassemblies by system of power and free conveyors pictured. Selector switch on each carrier directs it to its proper overhead storage destination, ready for instant use.

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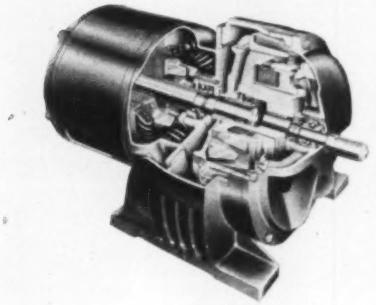
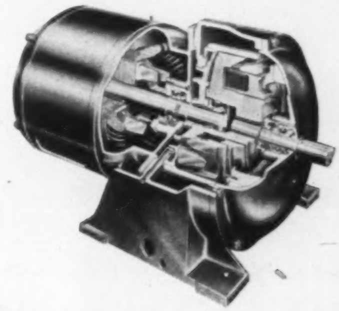


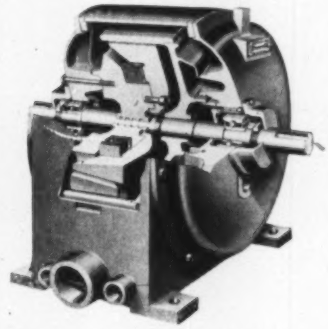
Ajusto-Spede® Drives

Dynamatic Ajusto-Spede® Drives supply infinitely adjustable speed from an AC power source—with low power losses and minimum maintenance. These air-cooled, stationary field, eddy-current couplings, integrally mounted with standard D-flange AC induction motors, provide a complete package-drive in sizes from 3 HP to 75 HP. Units of the same design and capacities are also available without motors.



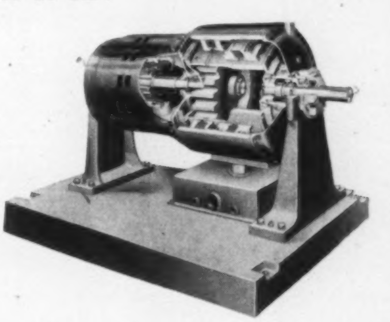
Dynaspede® Drives

These Dynamatic liquid-cooled, adjustable speed, Eddy-Current Couplings, integrally mounted with standard D-flange AC induction motors provide a compact self-contained drive in sizes from 3 HP to 75 HP. Motor types available are drip proof, totally enclosed fan cooled, and explosion proof. The coupling is completely enclosed. Separately mounted couplings are also available in capacities from 3 to 2500 HP and larger.



Eddy-Current Brakes

Dynamatic Eddy-Current Brakes are available in a wide range of torque capacities and operating speeds. Features include smooth, frictionless, shock-free operation with no rotating electrical components or contacts. Liquid-cooled types, as illustrated, provide loading requirements from 40 HP to 10,000 HP. Air-cooled units are available in sizes up to 50 HP.



Dynamometers

Three types of Dynamatic Eddy-Current Dynamometers are available to meet various testing requirements; absorption dynamometers up to 15,000 HP; motoring or driving dynamometers up to 500 HP; and universal dynamometers to 500 HP and larger. Special purpose dynamometers are also designed for use in applications where requirements are unusual.

Send for Illustrated Literature Covering these Dynamatic Units

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Now
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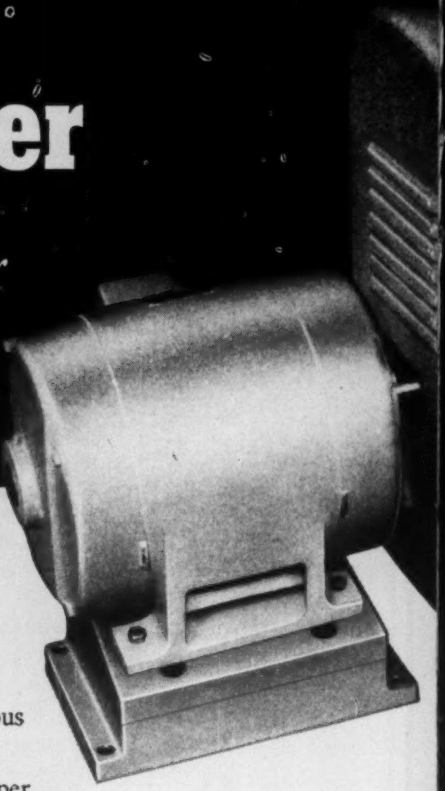
from
Le Blond...

No. 30 Rapid Borer

to Bore Holes Faster than Ever Before



With the new LeBlond-Carlstedt Rapid Borer, you can bore, trepan or counterbore holes *3 to 8 times faster than by the conventional D-bit method!*

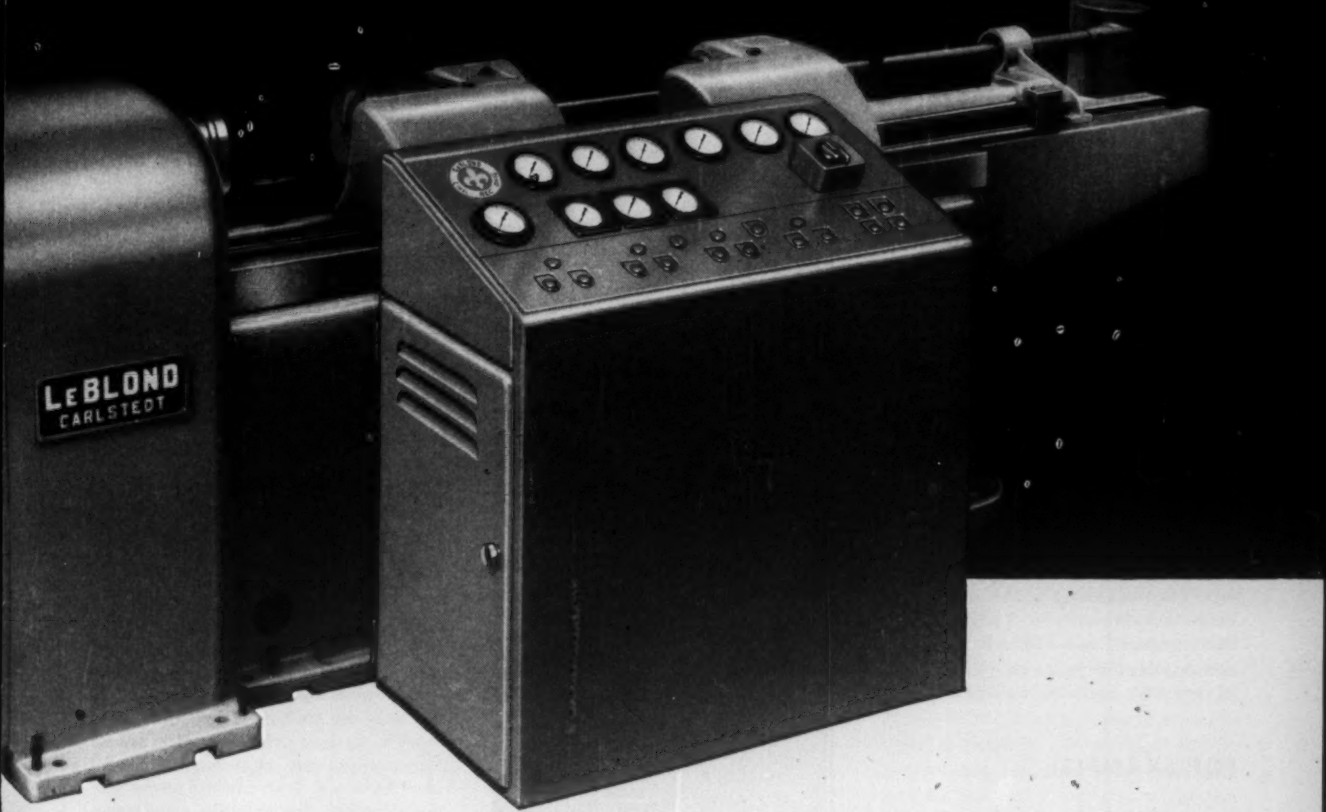
The Rapid Borer was developed expressly to accommodate revolutionary new tooling which cuts at very high speed with good accuracy and finish. Cutting oil is forced between the boring bar and hole wall forming a continuous bearing. It flushes back through a hole in the boring head and bar, carrying away the chips as it goes. Chip form is controlled both by tool angles and proper feed and speed combinations; thus tool faces are kept clean and chip passage clear. Cutter design produces balanced cutting pressures thereby controlling concentricity.

This new tooling requires a machine with the following characteristics, all of which are incorporated in the LeBlond Rapid Borer design:

High spindle horsepower
Ample rigidity throughout
Complete absence of vibration at all speeds
Infinitely-variable feeds (up to 38" per minute), independent of speeds, while running under load
Final drive to spindle through belts
Large volume of cutting oil

Basically, the Rapid Borer is suited to work that is symmetrical for balance in rotation—round, square, octagonal, tapered or stepped. A wide variety of hole diameters and depths as well as work sizes can be accommodated.

Tell us about the holes you'd like to produce faster. Large holes or small. If the Rapid Borer can handle the job, we'll show you how to produce them faster than ever before.



BRIEF SPECIFICATIONS, No. 30 RAPID BORER

Workpiece diameter	¾" to 6 11⁄16"
Boring and workpiece lengths (max.)	18", 42" or 66"
Solid boring	½" to 1¼"
Trepanning or counterboring	2⅜" max.
Spindle speeds	Single speed or variable to 2500 rpm
Main drive motor	30 hp

EXAMPLES OF WORK BORED IN OUR SHOP

1. Drive Shaft, 29½" x 2⅜"
Blind hole, 25" deep, .887" dia.
Material, 4140
Penetration rate, 6¼"/min.
Floor-to-floor, 5.5 minutes
Old method* floor-to-floor, 29.2 min.

2. Barstock, 13⅛" x 2⅝"
Through hole, 1,062" dia.
Material, C1141
Penetration rate, 7¼"/min.
Floor-to-floor, 3.2 min.
Old method* floor-to-floor, 19.4 min.

3. Barstock, 10 13⁄16" x 2⅛"
Through hole, 775" dia.
Material, C1141
Penetration rate, 7"/min.
Floor-to-floor, 3.03 min.
Old method* floor-to-floor, 14 min.

** Old method—conventional D-bit*

...cut with confidence

The R. K. LeBlond Machine Tool Company
Cincinnati 8, Ohio

World's Largest Builder of
a Complete Line of Lathes for
more than 69 Years

LeBLOND
of Cincinnati

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Progress Report:

SCHRADER AIR PRODUCTS CAN MAKE PRECISION OPERATIONS EFFICIENT

• Let's clear the air about close tolerances

We've faced it. Lots of manufacturers still think air is as unpredictable as the weather report. But others know better, because they've taken the time to let a little sunlight on the subject. These open-minded ones are utilizing Schrader Air Products, not just to hold work or blow away chips, but to produce complex units to close tolerances.

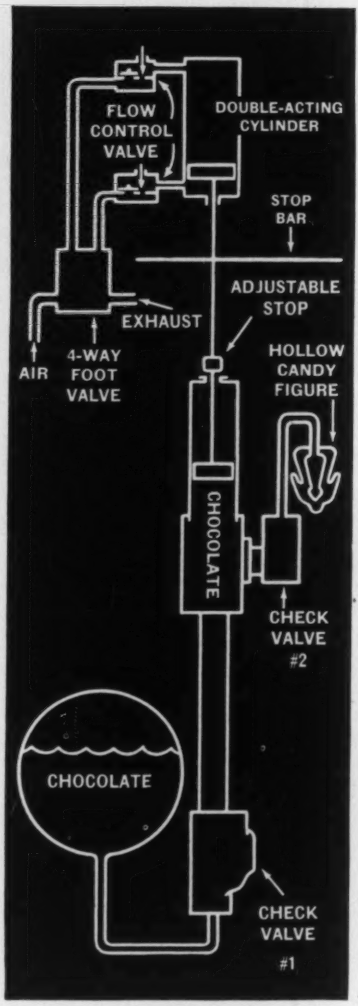
Air is a big boy now. It has grown up fast because automation came because pennies needed pinching. Because many operations in manufacturing turned out to be just plain dangerous. Then engineers found air was not only efficient, economical, and safe, but that products were already designed and produced to make air a logical way of performing hundreds of special jobs.

FOR EXAMPLE:

• Sweet words about air from a candy maker

At a Buffalo, New York, candy company, Schrader Air Products have been used to perform a complex measuring operation. To within one gram! Six Schrader double-acting cylinders are used to fill a bank of six more single-acting cylinders with a prescribed amount of chocolate. When a foot valve is released, the chocolate is forced into wax figurines, exactly filling them. And the entire installation is even covered and kept at a constant temperature to insure the proper chocolate viscosity.

Take a look at the schematic. It shows the arrangement by which the Schrader Air Products are adapted to an operation which might at first seem far outside the limits of air use. It was possible because some engineers put on their thinking caps.



Schematic shows how Schrader Air Products are adapted for precision handling of liquid chocolate.

• Talk about air's advantages being automatic—lend an ear

This is important to you, so don't wander off. When air is used to synchronize motions automatically, efficiency is almost sure to follow. BUT, the natural advantages of air multiply like rabbits. For instance, economy is basic. In many cases it can make the difference between profit and loss. Then, safety margins are widened by the use of special control techniques. Air's simplicity makes possible easy finger-tip and tiptoe operation of tiring hand and foot movements. Fatigue? Who's tired? Production goes up. Modern packaged control sets are so highly developed that most hazards of press operation are no longer applicable. Both hands must be used at once, and cannot stray into danger zones. Any machine using a mechanical clutch, shears, brakes and friction clutches can use special controls.

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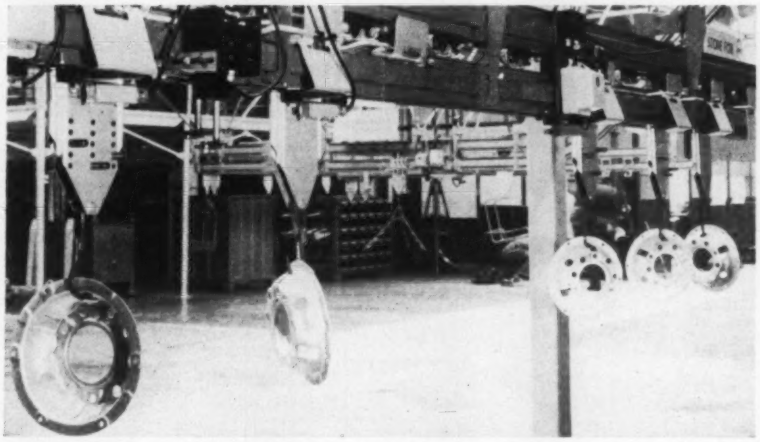
notes from britain

By **FRANK G. WOOLLARD**
British Correspondent



Advanced development of conveyors illustrates the effort being applied to obtain continuity in production and assembly operations. The carriers of this Flowmaster conveyor, developed by Fisher & Ludlow Ltd., are fitted with three selector pins which can be arranged in a given pattern to preselect a desired transfer point at which the carrier is directed off this conveyor line.

Continuity Is The Goal

AUTOMATION has been described as a new philosophy of production. This, to the practical man, may sound somewhat highflown, but Webster gives a definition of philosophy as: "the knowledge of phenomena as explained by, and resolved into, causes and reasons, powers and laws." If the laws controlling automation can be resolved, it could be very helpful to everyone who is interested whether as promoter or as user of the automatic method.

The central idea in automation is undoubtedly the continuity of operation and from the early days of the industrial revolution manufacturers have, consciously or unconsciously, been striving for continuity in the production processes. In early days the aim was instinctive rather than conscious but, with every forward step, the idea of continuity has become more definite, and more precise, and more deliberate. This being so it may be well worth while to examine the proposition, to ascertain whether it is tenable and, if so, how we can use it to help more and more producers to consider automation as part of their manufacturing policies. It may be here remarked that the word manufacture has become a complete anachronism when referring to modern production methods, and particularly to automation, for which a much more suitable term would be "autofacture."

Before the industrial revolution, work was, for the most part, carried on in the home or in adjacent barns by the master and a few men with, perhaps, a couple of apprentices—very much as indoor work could be done on a farm. In due time independent workshops were set up but the tasks were by no means continuous and frequently they were unrelated one to the other. Later these workshops grew and became "Works" where large projects were carried out or a "manufactory" — soon to be shortened to "factory" — where quantity production was undertaken. In these factories the batch system was evolved but this was discontinuous because the machines were grouped in shops or departments according to type—lathes, milling machines, drilling machines and so forth. This involved the movement of batches of piece parts from one department to another and where accuracy was required the piece parts had to pass through an inspection department before going on to the next operation.

In the assembly of motor vehicles, however, it was seen that, if the chassis frame could be mounted on wheeled axles, it would be possible to move it from station to station at which specific units could be added. In all probability it was this, more or less, fortuitous adaptation of a natural situation that led to the conception of the conveyor assembly line.

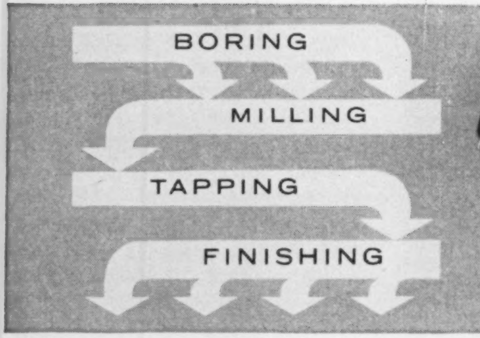
Development of the Flow Line

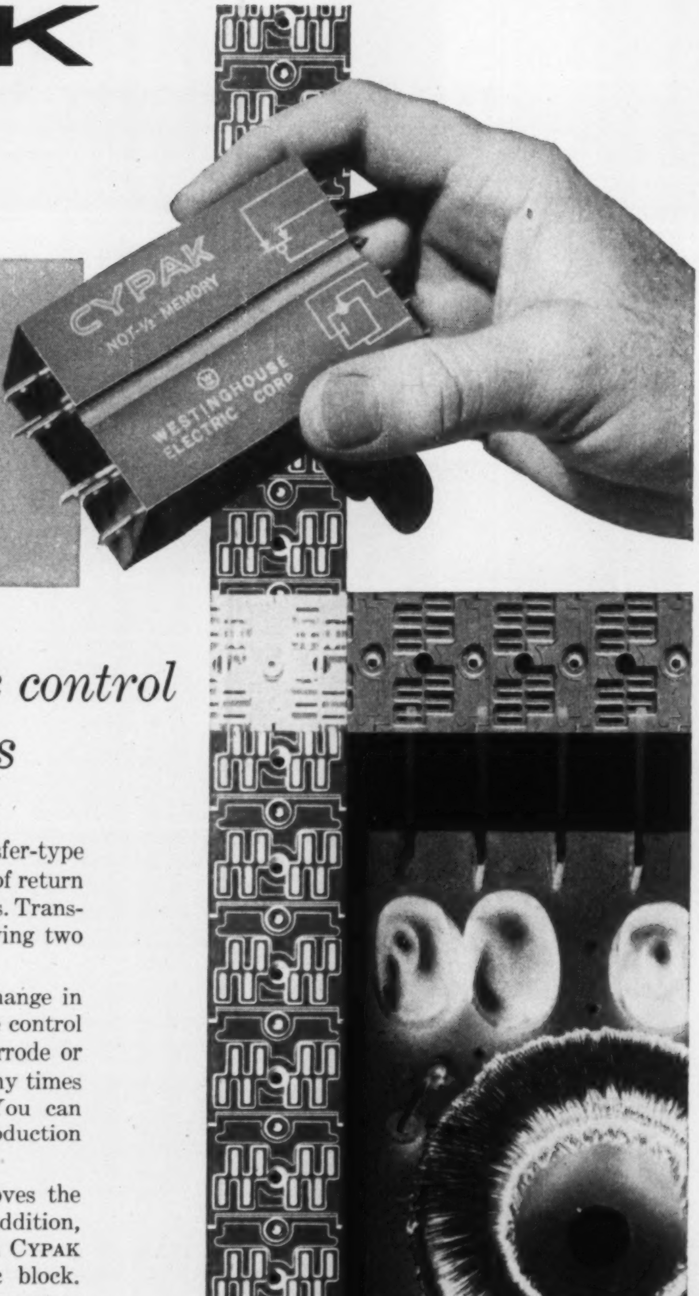
As the lesson of the assembly was absorbed, engineers grasped the idea of continuity in production and gave consideration to the economics of machine lines with the machines laid out in operation sequence instead of being grouped according to type. Thus the flow line was developed with lathes, milling machines, drill presses and other tools in line and with the inspection bench at the end of line. Later heat treatment was brought into line with the machining processes, where this was regarded as desirable, to promote continuity. These machines and processes were linked by conveyors of differing types: belt or pendulum conveyors were often employed but in many instances roller track or even simple slides were used.

The next forward step was the

CYPAK

AT WORK...





simplifies automatic control of transfer machines

When you're considering the cost of transfer-type machining operations, look at the new areas of return from the simplicity of CYPAK* control systems. Transfer machine installations of CYPAK are proving two important facts.

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introduction of the automatic transfer machine by which the flow line was consolidated by grouping the machine heads on a common base which carried a long continuous worktable; this worktable being provided with mechanisms to carry the workpieces from station to station throughout its length. Such transfer machines can have as few as two stations or as many as needed. Moreover these machines can be coupled by interoperation transfer shuttles, better described as linking devices. These help to promote continuous flow so that a large section of a machine shop or even a whole department can be automatically operated.

When we look back on this development we can see a logical trend towards continuity in operation and as we look ahead the same trend is obvious. In all the forward steps in machine shops the idea of continuity is paramount and this also is true for all other industries where automation is being applied: the aim is always to establish a perfect continuum.

Problems to be Solved

The advent of the automatic transfer machine did not, of itself, provide complete continuity of performance. There were, and are still, many interruptions in the sequence of operations to be overcome. Some of these are incidental hindrances and others are unpredictable stoppages. Among the former interruptions are tool changing, inspection, chip removal and lubrication problems, while among the unpredictable stoppages there will be tool failures, impacted chips and failures of operating or control mechanisms.

All these interruptions to continuous operation have received attention but all the remedies are rarely embodied in the same machine. Delay due to tool changing has been reduced in incidence, it has been organized by scheduled attention and assisted by mechanical aids, but it has not been, so far, eliminated. Inspection which, if done manually, is a slow process has received attention and would appear to be on the way to complete automation. Chip removal would appear to be an automatic possibility but to make it really effective the factory building should be designed to accommodate the necessary apparatus. Lubrication delays can be eliminated. by building the oiling system into the machine and this has largely been accomplished.

The stoppages which are purely unpredictable can be safeguarded but accidents will occur in the best-regulated factories. The most common trouble is due to tools—broken tools can cause considerable delay. This can be largely overcome by proper tool inspection, regular changes of tools and sharpening whether it appears to be necessary or not and by setting speeds and feeds to suit the tools. The transfer machine is not so liable to interference by operators as the individual machine and will therefore give longer tool life with less accidental trouble. Impacted chips can present problems but these are not usually difficult of solution.

Unforeseen breakdown of the operating heads or other mechanism can best be provided against by regular inspection as a part of preventive maintenance. The control system plays an important part in this matter and instances have been known where limit switch failures have resulted in very serious accidents to the mechanism. The author knows of one case where, due to failure of a limit switch, the main body of a multidrill head was broken through. The substitution of electronic controls would appear, in theory, to provide a solution to this kind of accident since electronic controls are less liable to be affected by mechanical wear, suds and dirt.

The Logic of Automation

The author has used the transfer machine as a stalking horse for his contention that the root idea behind all automation is continuity of process, but it is equally true of any process: it is not confined to the machine shop nor to metalworking. It applies to flow processing of liquids, fluids and semifluids and even to computer accountancy and the like. Upon close investigation it will be found that the whole logic of automation can be succinctly summed up in the phrase "continuous operation" or the single word "continuum."

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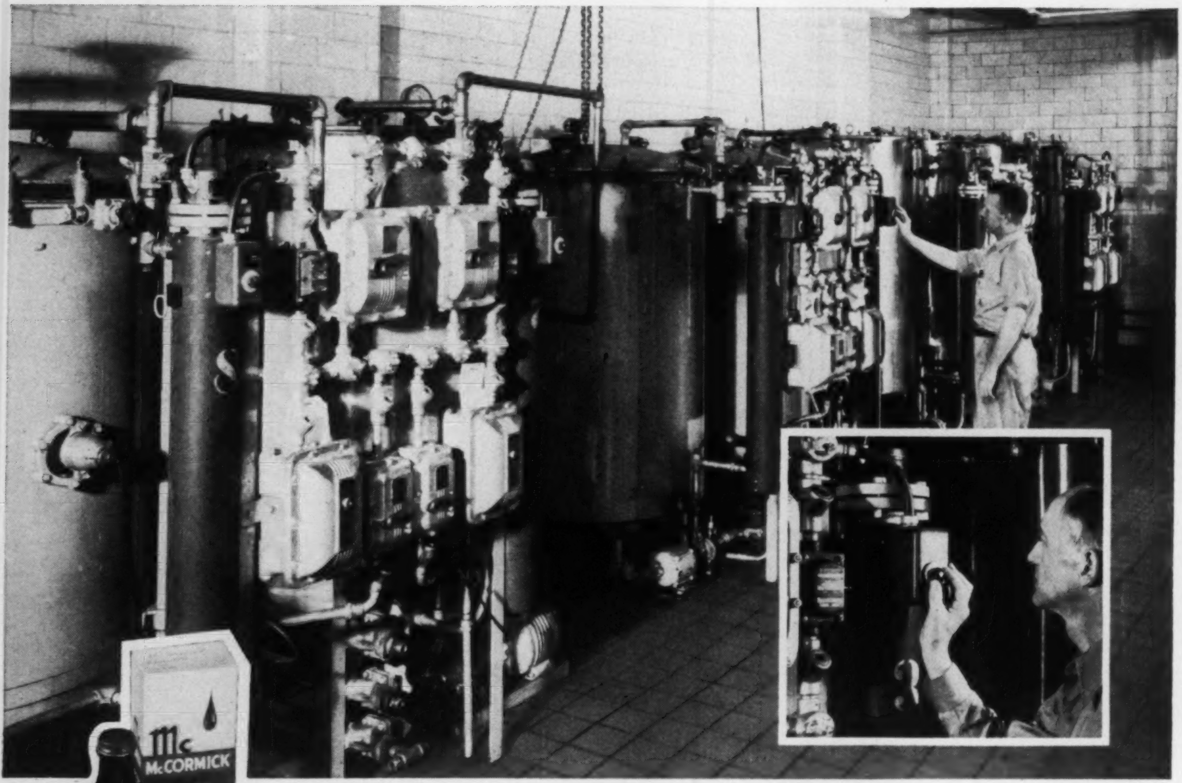

From these McCormick & Company, Inc. percolators, gallons of pure vanilla extract are produced daily. (Inset) Maintenance Supervisor setting the Chromalox Automatic Thermostat to exact degree for optimum extraction.

Chromalox Electric Heat

saves processing time, raises output

Vanilla Extract, as found in every kitchen and soda fountain, is the result of repeatedly passing alcohol through chopped vanilla beans. The process formerly took several days of constant recirculation in the percolators at McCormick & Company, Inc., in Baltimore. Then the company found that processing time could be drastically reduced by mildly preheating the alcohol agent before each contact with the beans.

To overcome the hazard of bringing heat into contact with highly volatile alcohol, McCormick chose and installed a Chromalox Electric Circulation Heater on each of the eight percolators. Results: safe, clean heat, with hairline temperature control; output of equipment was increased and production time reduced. Each part of the heater coming in contact with the circulating extract was tinned before assembly to maintain the highest purity standards.

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Size or Ingenuity?

Time and again the question is raised concerning the prospects of small plants applying the principles of automation.

Apparently there is considerable misconception that in large measure automation is the province of the industrial giants. A little research will show that automation application has relatively few restrictions, least of all plant size or employment.

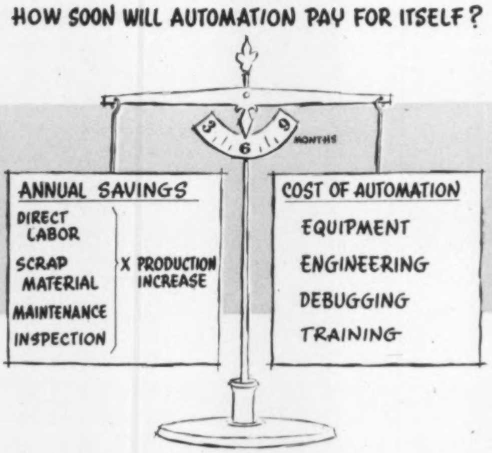
Basically, the major requisite needed is sufficient volume of production run or a steady market. Historically, automatic production got its start in small plant operations with products of stable character and continuous market demand. Developments in production of such items as cloth, rugs, magazines, flour, foods, bottles, toys, toothpicks, lamps, and matches bear this out. Only in recent years has volume demand made automation feasible in other fields like automobile and appliance manufacture.

Talent and manufacturing know-how are not the special preserve of any particular size of concern. Ingenious product design, processing and equipment are the main factors in effecting automatic production. Anyone can achieve the desired goal —with determination and good management. Even in the cases where lots are modest, automatic programed machines having low setup cost can provide similar advantages in decreased unit costs and improved quality.

Case histories of small companies on record—with a wide variety of products—show impressive results. Pointed comment by such manufacturers that "automation is our salvation" and "automation is the secret of our success" are no idle words. Some of the basic considerations to be made are outlined in the first article in this issue.

A hard look at business statistics shows that 93 per cent of all manufacturing firms employ fewer than 100 people. New and expanded applications of automation in this vast field, ranging from simple electrical controls to highly advanced production systems, offer unlimited challenge and opportunity for the future.

EDITOR



DEVELOPING SMALL SCALE AUTOMATION

Small-scale or simple automation is useful and profitable for the large manufacturer as well as the small. How can small-scale job operations be successfully automated? What are the main criteria? Practical automation requires a new approach, new thinking and perhaps a different plant setup.

By F. F. WHITE
Vice President-Engr., Automation Development Corp., Willoughby, Ohio

FOR THOSE SEARCHING for the common denominator of automation, the quintessence of what automation represents to everyone, I suggest the following:

First, automation is something old, for in it there is gathered all the wisdom inherent in manufacturing since the start of the machine age—the methods, the gadgetry, the mechanisms, the engineering sciences. This is the foundation and the background of automation, and always will be an inherent part which should never be ignored or forgotten.

Second, automation is the problems of today and the steps we are taking to solve them. Primarily the problems are how to continue to raise the standard of living; how to give more people more material return for their labors; how to enable them to have the opportunity for healthier, more educated and happier lives. There are the problems of inflation, and limited physical efforts of available labor force to produce for almost limitless consumer demand. In addition, there is the goal of releasing human beings from routine, physically wearing work and allowing them to develop more of the mental skills involving training and judgment. Helping us solve these problems is a series of new developments and techniques, some now so accepted as to be commonplace, but centered about electric power, the electric motor and electrical control devices.

Third, automation is our plans for tomorrow. We envision the completely automatic plants of the future. Manufacturing will be accomplished almost entirely by flexible, automatic machines. Human ingenuity will be devoted to development of new and improved products to better serve mankind, produced uniformly and at least cost.

Fourth, automation is enthusiasm. You will hear enthusiasm throughout this conference. People in automation realize what they are doing carries on the tradition of ingenuity, of progress, self development, and leadership. Our feeling is not only that our free way of life is the best way of life, but that here we have a tangible means of proving it and, therefore, we're enthusiastic about it.

What is Small-Scale Automation?

Many a corporation executive, confronted for the first time with the need for automation in his own comfortable and well-run plant, has a feeling close to terror. He envisions gigantic capital expenditures for long, streamlined machines inter-

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This article is based on a paper presented at the "First Conference on Manufacturing Automation" cosponsored by AUTOMATION and Purdue University, October 1956.

locked with complex control systems. He sees present and profitable production machinery, not fully depreciated and operating satisfactorily. This, he thinks, he must exchange for a new and untried process with possibly golden but remote future profits. Clearly, to reassure a justifiably skeptical management, there should be a "foot in the water" approach to automation instead of a "dive into water" which may prove cold.

Small-scale automation is the answer to the need for a modest and reasonable approach. It can be very profitable although simple. It can be applied to existing machinery and processing techniques. The moderate capital investment can be returned quickly and reinvested as fast as desired. Small-scale automation is ideal for the small plant. It is also the trend in big plants where large and complex special machinery has become inflexible and clumsy, where maintenance costs are high and shutdowns are crippling.

Today the tendency is to automate by plan—unit by unit on a small scale. Then the units are integrated into flexible sections, or entire plants where their production records are spectacular.

Small-scale automation may be defined as the maximum approach to mechanization of one or more machining or assembly operations with a clearly indicated incentive in view. It may be applied as an adaptation to one or more machines already in operation, or it may be applied to a special machine or machines. Although not limited in size the workpieces involved are generally small. Small-scale automation is capable of being integrated into an overall automation system, but fully justifies its existence on a unit basis.

▶ Why Automate at All?

Before starting upon any automation program, there must be a clearly indicated incentive. The engineer must ask and answer certain basic questions which have become axioms of automation. These are:

1. *Can the operation be combined with a previous operation or a subsequent operation, or be eliminated entirely?* Although this question may have been asked and answered before, it is important that it not be overlooked as one of the simplest of all solutions to the problem.

2. *Is parts volume sufficiently high?* Very often similar parts can be grouped together and run off with a minimum amount of tooling changeover. However, make certain that there is a sufficiently high volume of parts to run before automating.

3. *Is direct labor a high per cent of product cost?* Direct labor savings is perhaps the most prevalent and spectacular justification of automation. The number of direct labor personnel saved is a rule of thumb guide as to which operation or series of operations to automate first.

4. *Is scrap a high per cent of product cost?* The automatic machine is not affected by fatigue of arm or eye, nor is it careless or forgetful. The automated operation should produce uniformly high quality—eliminating classification and selective fitting in assembly.

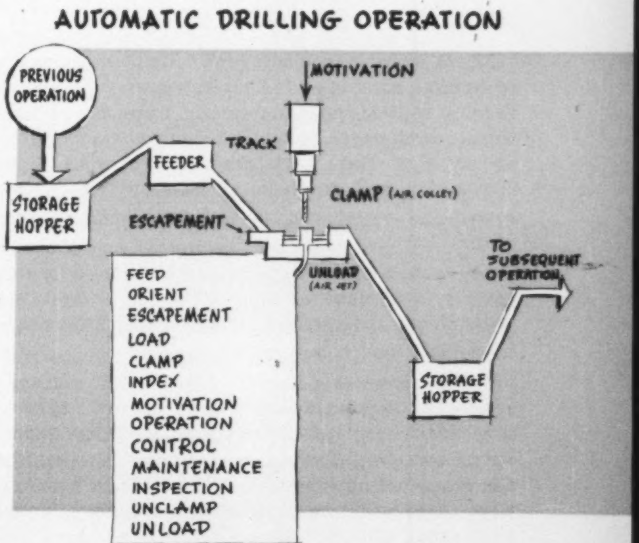
5. *Is material a high per cent of product cost?* A certain amount of material will be lost in setup and adjustment of an automatic operation; however this can be minimized by good machine design, and overall scrap saving should be considerable.

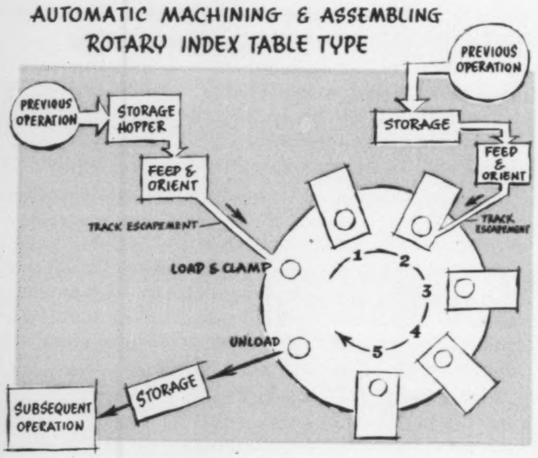
6. *Is production rate high enough?* Operating tirelessly, the automatic machine can invariably outperform the human operator. By securing much greater production from less machinery, spectacular cost savings can be shown. But the subsequent operation must be able to absorb the increased production, and the previous operation must be capable of supplying the stock required.

7. *Are inspection costs high?* Use of 100 per cent inspection and segregation of rejected parts into salvageable and unsalvageable material is costly, as is classification of parts into selective fits. Automation has a great deal to offer in the inspection field. If tolerance is critical, the automated operation can inspect its own work and adjust if necessary. In case of serious out-of-tolerance the automated operation shuts itself down and signals for attention. Scrap is minimized by feedback control—and uniformity of production often eliminates selective assembly. Cost savings here are impressive.

8. *Is machine utilization time low?* Many an automatically cycled machine awaits the operator while he loads and unloads the workpiece. With automatic loading and unloading, the automated machine does not wait for the indeterminate time when the operator will press the START button. The resultant output of the automated machine is far greater.

9. *Does product model changeover greatly affect this operation?* Although small-scale automation is outstanding in its flexibility, nevertheless it is more time consuming to change over an automatic than a manual operation. Those parts least af-




AUTOMATIC MACHINING & ASSEMBLING
ROTARY INDEX TABLE TYPE
PREVIOUS OPERATION
STORAGE HOPPER
FEED & ORIENT
TRACK ESCAPEMENT
PREVIOUS OPERATION
STORAGE
FEED & ORIENT
TRACK ESCAPEMENT
LOAD & CLAMP
1
2
3
4
5
UNLOAD
STORAGE
SUBSEQUENT OPERATION

fected by model changeover should be automated first.

10. *Is plant space limited?* Automated machine components are usually grouped closely giving high utilization of floor space. Higher production per unit also greatly conserves floor space.

11. *Can the part be redesigned for automated operation if necessary?* This is the question which makes the sales manager and production manager shudder. From the standpoint of replacement parts in the field, the question may pose some serious problems. However, the cost savings from a relatively simple redesign may be so important to all that it cannot be overlooked. The redesign will change what would otherwise be a complicated automated process into a relatively simple one.

12. *Is there a shortage of operators?* If a sufficient supply of skilled operators is available at reasonable rates, certainly much thinking should be done before automating. However, General Electric predicts that by 1965 customer demands for goods will be up 40 per cent while the available work force will rise only 14 per cent. The lack of sufficient skilled workers is a basic factor in the very rapid growth of automated processes.

13. *Is maintenance cost high?* Maintenance costs of several hand-operated machines may be higher than a well-designed automatic operation. Sometimes maintenance costs are hidden when operators do some of their own maintenance work. Tool sharpening and replacement costs will be lower because of closer control and uniformity of tool usage.

14. *Is the operation undesirable?* Is it noisy, smokey, dangerous or undesirable for some other reason? The automated operation cares little about its environment or any safety hazard.

15. *Is supervision limited?* Every plant manager knows the important role played by alert, aggressive supervision. Often expansion stretches supervision too thin. The automated machine requires the minimum of supervision. It can shut itself off when production is completed, or flash a signal light when attention is required.

After answering these basic questions, the engineer will have a clearer understanding of what is most needed. On the other hand if there is doubt and uncertainty—proceed to other operations which may need automation more. By the time the doubtful operations are returned to, they may have clarified themselves. What is intended is not to slow down the switch to automation but rather to focus attention on those operations which need automation first.

▶ How Soon Will It Pay for Itself?

Having answered the basic questions of *Why Automate at All?* the engineer has a concept of possible savings available from ideal small-scale automation. Roughly computed, these savings should be expressed in dollars as potential savings in one year of ideal automated operation.

Using this rough dollar figure, the engineer next asks himself: Can it be automated to pay for itself in the first six months of operation? Why six months? Small-scale automation which cannot pay for itself within the first six months of operation should be entered into only with extreme caution, if at all.

A six-months payoff is within both the fiscal year, and a possible annual model change, or obsolescence. A capital investment approaching a payoff period of one year is a major investment, and should be deferred unless there are pressing reasons and until all other operations which can payoff in six months or less have been evaluated.

Small-scale automation is a fundamental engineering technique which can be applied with startling similarity and startling results in many basic industrial processes. The six-months rule has proved itself a sound and practical dividing line for selecting the most important projects.

If the savings per year—half of which are available to pay for equipment, engineering, debugging and training—are absurdly low, then the same analysis should be applied to other operations.

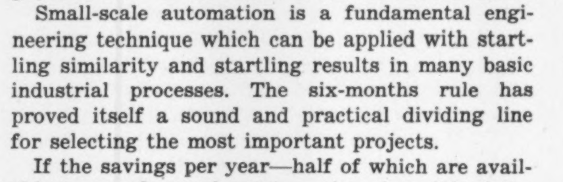

SUBSEQUENT OPERATION
AUTOMATIC MACHINING & ASSEMBLING
MULTIPLE STATION ASSEMBLY MACHINE
STORAGE
UNCLAMP UNLOAD
TRACK ESCAPEMENT
LOAD CLAMP
FEED & ORIENT
FEED & ORIENT
FEED & ORIENT
12
11
10
9
8
7
6
1
2
3
4
5
1 TO 12 ARE WORK STATIONS
FEED & ORIENT
STORAGE HOPPER
PREVIOUS OPERATION

TABLE 1—Automation Evaluation

TERM	EXPLANATION	COMMENT
Previous Operation	The manufacturing operation immediately preceding the operations under study. Or the raw material source. Can previous operation be simplified or eliminated?	Indicates the dependence of successful automation on an adequate source of pieces of uniform quality.
Storage	The bank of pieces required in case of previous operation failure, also to keep the feeders of the automated operation constantly supplied.	May be large storage hoppers with built-in elevating conveyor for supplying feeder.
Feeder	Handles the raw material or workpiece required for the operation. Often orients.	Bar, coil & strip feeder. Mechanical transfer, vibratory, tumbler, and blade type feeders.
Orientation	Automatic positioning of the workpiece, dependent on physical characteristics of the part.	Accomplished by curved or slanted tracks, vanes, guides, slots, air streams and special devices.
Escapement	Release of one part at a time. Complicated by interlocking or overriding parts.	Accomplished by lever, or cam.
Loading	Uniform placement of workpiece in work fixture. Required for accuracy and uniformity of product.	Accomplished by gravity, claw, magnet, pushrod, vacuum cup, lever, air jet.
Clamping	Secure holding of workpiece in work fixture or position. Especially required for precise work or heavy stock removal.	Accomplished by collet, cam, spring, air cylinder, toggle, stripper plate.
Indexing	Means of accurately moving workpiece from one work station to another.	Accomplished by transfer, rotation, turn-over; horizontal or vertical, intermittent or recipricatory motion.
Motivation	Power required by bringing tool and workpiece together.	Cam, air or hydraulic cylinder, crank, toggle, gear, solenoid, screw.
Operation	Power required to actually perform machining or assembly operation.	Power source usually same or similar to motivation.
Control	Proper sequence and timing of escapement, loading, clamping, indexing, motivation and operation, inspection and unloading. By feedback from inspection station either corrects out-of-tolerance or shuts down operation. Also shuts down in case of jamming, or failure of any function, or overload.	Limit switches, cam valves, stepping switches, proximity switches, photoelectric devices, relays, timers, solenoid valves, magnetic amplifiers, etc.
Maintenance	Through control, shuts down machine when tool is dull, or overload of any kind occurs before damage to the machine.	Current and voltage limiting devices, pressure switches, strain gages.
Inspection	Provides impulse for control device to correct or shut down machine.	Air gage, dial indicator and plug gage devices.
Subsequent Operation	Manufacturing operation immediately following the operations under study.	Workpiece can often be delivered oriented for subsequent operation. May be simplified or eliminated.

▶ How to Automate on a Small Scale

If the rough analysis indicates that the automation project will pay for itself in six months or less, or if there is other good and sufficient reason, then analysis should proceed in more detail.

A manually operated drill press, symbolic of the standard machine tool, will illustrate what we must examine: Workpieces are obtained from the *previous operation,* (it may be a steel mill or a foundry) and placed in a *storage* container or area. Operator selects single workpiece (*feed, orient, escapement*), places it in the work holding fixture (*load*), *clamps* the workpiece in the fixture, centers the workpiece under the drill head (*index*), lowers the quill bringing drill in contact with workpiece (*motivation*). Drill press motor rotates drill (*operation*), operator determines depth and size of hole (*control*), changes drill if dull (*maintenance*), *inspects, unclamps, unloads,* and places in *storage* for *subsequent operation.*

The symbolic drill press may be automated as follows: An adequate supply of workpieces is brought from the previous operation into a storage area, or hopper, (which automatically supplies the feeder). The feeder orients the workpiece and delivers it to the escapement, which selects one piece, releases it for loading into a fixture where it is clamped, indexed, motivation is initiated, and the drilling operation commences. The power required for drilling is monitored automatically should the drill become dull and require replacement, in which case the machine shuts itself off. An air gage probe is automatically lowered into the hole to blow out chips, measure size and depth. The workpiece is unloaded by exhaust air from unclamping, and the workpiece is delivered to storage for the subsequent operation.

This illustration, applied to the simplest of the standard machine tools, is important because such a standard machine tool is generally multipurpose, has the flexibility to be readily retooled for other

WILL SMALL SCALE AUTOMATION WORK?

SOME TYPES OF

SUCCESSFULLY AUTOMATED STANDARD MACHINERY

PUNCH PRESSES
PRESS BRAKES
SHEARS
FORGING MACHINES
DIE CASTING MACHINES
ENGINE BLOCK MACHINES
BROACHING MACHINES
TREAD ROLLING MACHINES
INDUCTION HEATING MACHINES
FLAME HARDENING MACHINES
CUT OFF MACHINES
SCREW MACHINES
SINGLE SPINDLE MACHINES
AUTOMATIC LATHES
TURRET LATHES
BORING MACHINES
TAPPING MACHINES
REAMING MACHINES
DRILLING MACHINES
GEAR HOBBERS
GRINDERS
LAPPING MACHINES
SCREW ASSEMBLY MACHINES
RIVETING MACHINES
SWAGING MACHINES
SOLDERING MACHINES
HEADERS
WELDERS
INSPECTION MACHINES
SORTING MACHINES
STACKING MACHINES
COUNTING MACHINES
WEIGHING MACHINES
DEGREASING MACHINES
ETCHING MACHINES

jobs, and is in general use. The standard machine tool builder can amortize his design engineering cost over the expected sales volume and give a distinct advantage in original cost of the machine. Furthermore, automatic cycle machine tools are increasingly available containing their own clamping, indexing, motivation, and operation features which greatly simplify automation problems.

Side by side with the standard machine tool is a basic machine for automation which is the center of machine tool or assembly operations. It is the assembly machine, and has two fundamental forms:

Index Table: First, there is the multistation index table around which may be grouped various machines or assembly operations, or any combination of both. One station is required for loading, and one station for unloading. The index table is basic because it can be retooled with a variety of work-holding fixtures, and a wide assortment of operations can be grouped around it. Its limitation is physical size, and number of index stations.

Multiple-Station Assembly Machine: Although this machine can provide an almost unlimited number of work stations, the economics of small-scale automation limits the number of stations to maintain flexibility, and to keep capital costs in line. The workpieces, mounted in fixtures are moved about the periphery of the machine by chain. Accuracy is maintained by either floating the tool or the work-holding fixture. The center portion of the machine may be used for a variety of feeding devices, or machine tools, or special machines. A line shaft with cams extending the length of the machine coordinates timing of motions, and a variable-speed intermittent drive provides a variety of speeds and dwell times.

Using the standard machine tool, or the standard assembly machines as fundamental building blocks for the automation project, we should examine the automation points outlined earlier and shown in TABLE 1. The automation project under consideration should be examined point by point as indicated. How suitable is the basic equipment at hand? Will the workpiece lend itself to handling and inspection by standard equipment which is available? How much layout and special engineering will be involved? In the engineering and building and assembly budget there should be ample time for solving and correcting problems which will not appear on paper.

Finally, purchase orders and detailed instructions must be written, drawings started and plans for a training program initiated to prepare plant personnel for the impact of automated operation.

▶ Will Automation Work?

Although automation has proved itself beyond a shadow of a doubt, still with each new automation project, the question always arises—will it work *this* time? Will it pay for itself within the estimated period? Will it turn out the production expected of it? Was some salient factor overlooked? Was wrong equipment, or faulty design incorporated?

Generally, there should be little risk if the following points have been adequately covered:

1. Will the automated process be obsoleted by a model change, product development or process simplification?

2. Is there sufficient economic justification? Will the automated operation pay for itself out of its own cost savings in six months or less of operation?

3. Are there serious size variations or irregularities in the basic process?

4. Does the product have the best and simplest possible design for automation?

5. Is the automation project attempting to do too much or too little? In short, is it getting the most for its money?

6. Does the automation design incorporate the best suitable materials and components? The best engineering and ingenuity available?

7. Is sufficient time allotted for debugging and proper training of maintenance, setup and supervisory personnel, and sufficient technical personnel available to service the machine when required?

8. Are plant personnel willing to accept the new automation installation?

9. Are nuts, bolts, solenoid valves, switches, springs and relays standard? Will sufficient stock of all spare parts be kept on hand?

10. Will a rigorous and regular lubrication program be followed?

The list of tools and equipment which have been successfully automated grows every day. Not only are equipment manufacturers beginning to furnish standard automation packages, but feeders, controls and inspection devices are being improved in reliability and flexibility so that the engineer may minimize cost and uncertainty and concentrate on those points which are clearly special for special design engineering.

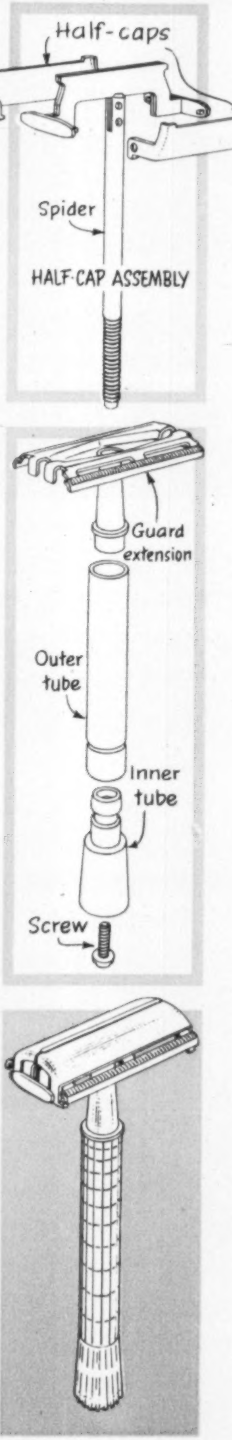
AUTOMATION TODAY

ASSEMBLING RAZORS AUTOMATICALLY

By **E. M. SULLIVAN** and **C. O. MERCHANT**

Supt. of Engineering Div.
Gillette Safety Razor Co.
Boston, Mass.

Chief Engineer
Swanson-Erie Corp.
Erie, Pa.

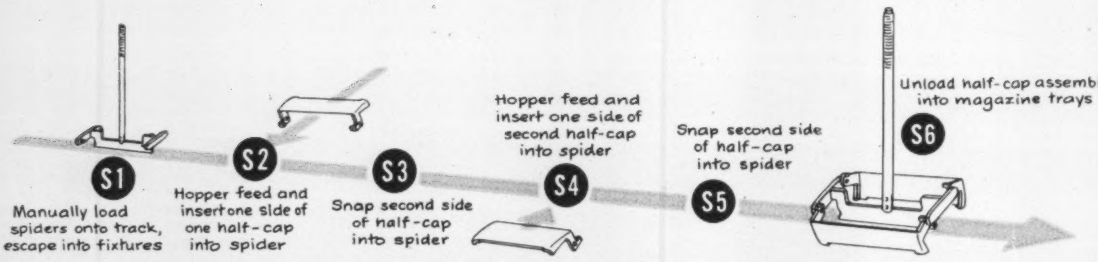


1

These seven major components go into each Gillette safety razor. Assembly into completed razors formerly was a manual operation, but two automatic machines have now been developed for the job.

INFLATION steadily has pushed the prices of all commodities higher and higher with a few notable exceptions. Despite the manufacturing economies of mechanized parts production, prices continue their upward spiral. One of the exceptions is the familiar Gillette safety razor. Years ago the price of a Gillette razor and six blades was a dollar. Today the price still is a dollar — and it's a better razor. To bring about this situation the Manufacturing, Industrial Engineering and Process Engineering Departments at Gillette have been continually working on the problem of costs. Time after time they have found ways to increase production-per-machine, or to reduce costs-per-unit, or both. About a year and a half ago it was felt that a practical limit had been approached in the field of mechanized parts production, and attention was focused on mechanized assembly. Broadly speaking, manufacturers have many reasons for turning to automatic assembly, such as lower cost, greater production, improved quality, safety for operators, and reduction in scrap. In the case of Gillette, the first reason — lower production costs — prompted the company to seek a solution in automated assembly.

Many Gillette razors are now assembled automatically. Two separate machines were designed, built, and tooled by Swanson-Erie Corp. and were recently put into operation and soon will be in full production. A few minor problems have been encountered, some having to do with tolerances on the parts to be assembled — but these are rapidly being solved. Gillette's production of Super Speed Razors — light, medium and heavy types — is 45,000 per day. The two Swanson automatic machines, running at 100 per cent efficiency, will produce all of the medium razors, or about one-third of the daily total. With slight modifications, additional machines can be built to handle the light and heavy razors as well. So far the assembly phase of Gillette's automation program has freed 15 operators from manual assembly functions. These operators have been transferred to inspection and


S1
Manually load spiders onto track, escape into fixtures
S2
Hopper feed and insert one side of one half-cap into spider
S3
Snap second side of half-cap into spider
S4
Hopper feed and insert one side of second half-cap into spider
S5
Snap second side of half-cap into spider
S6
Unload half-cap assembly into magazine trays

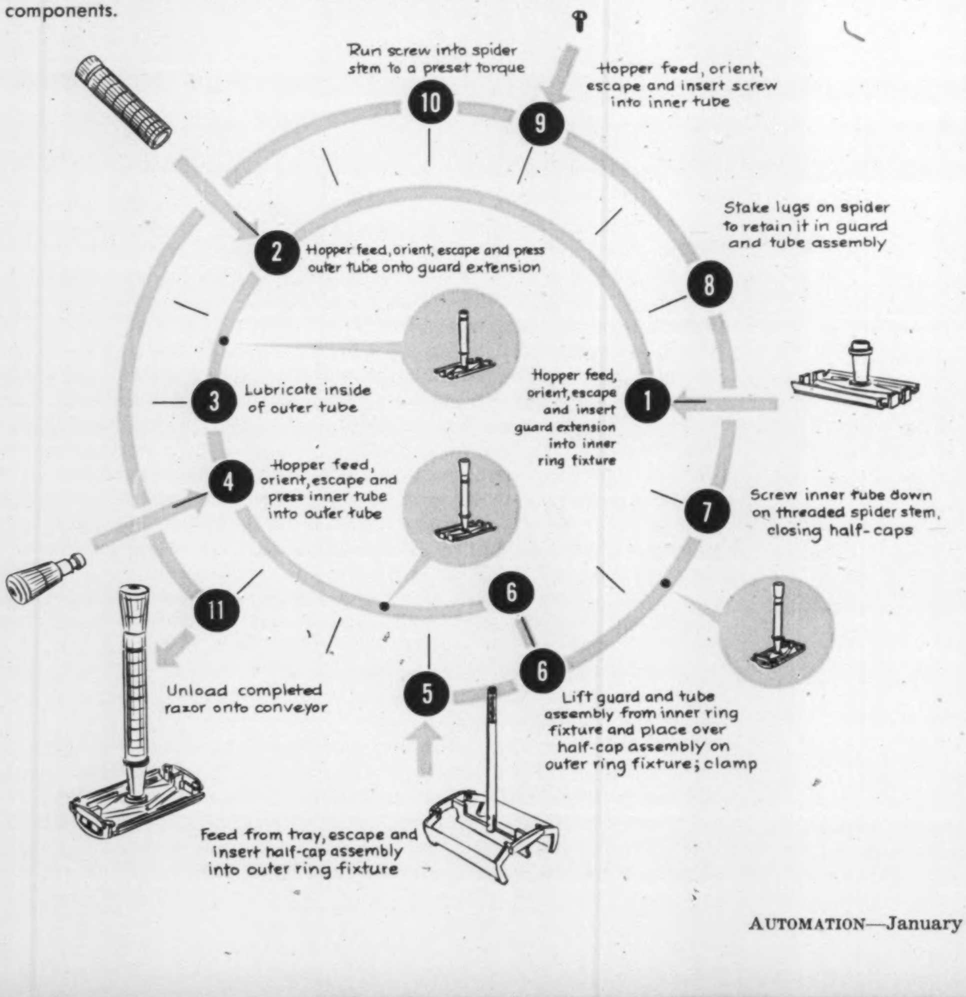
2

This sketch illustrates operations performed on one of the machines. Half-cap assemblies, consisting of a spider plus two half-caps, are automatically assembled at a rate of 60 per minute.

other jobs where human skills are more appropriately used.

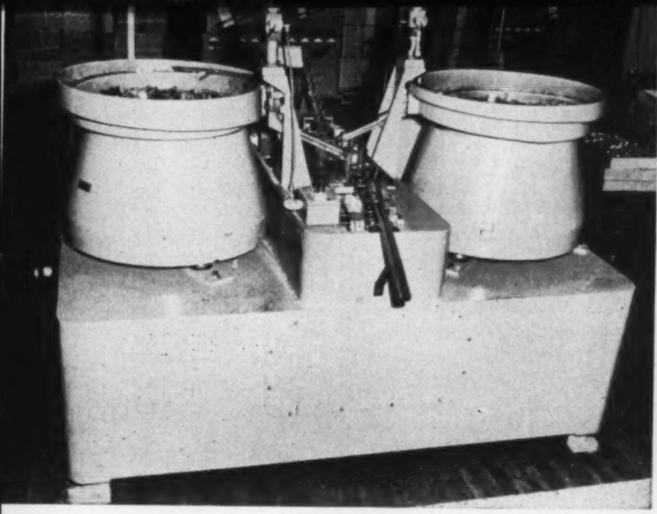
A Gillette razor has seven main components. Three of these parts—the spider and two half-caps—make what is called a half-cap assembly. These assemblies are put together on a special in-line machine at a rate of 60 per minute. Spiders are fed manually into a chute; vibrating feeders supply half-caps to each side of the spider; the half-caps are sprung into place; and the assemblies are chuted out for manual loading into trays which serve as oriented storage magazines. It should be noted here that Gillette has plans for automatically loading the completed half-cap assemblies into the trays. Like so many others who are pioneering in the field of automatic assembly, this company is tackling one phase of the job at a time.

Complete razors are assembled on a second machine at a rate of 30 razors per minute. This


1
Hopper feed, orient, escape and insert guard extension into inner ring fixture
2
Hopper feed, orient, escape and press outer tube onto guard extension
3
Lubricate inside of outer tube
4
Hopper feed, orient, escape and press inner tube into outer tube
5
Feed from tray, escape and insert half-cap assembly into outer ring fixture
6
6
Lift guard and tube assembly from inner ring fixture and place over half-cap assembly on outer ring fixture; clamp
7
Screw inner tube down on threaded spider stem, closing half-caps
8
Stake lugs on spider to retain it in guard and tube assembly
9
Hopper feed, orient, escape and insert screw into inner tube
10
Run screw into spider stem to a preset torque
11
Unload completed razor onto conveyor

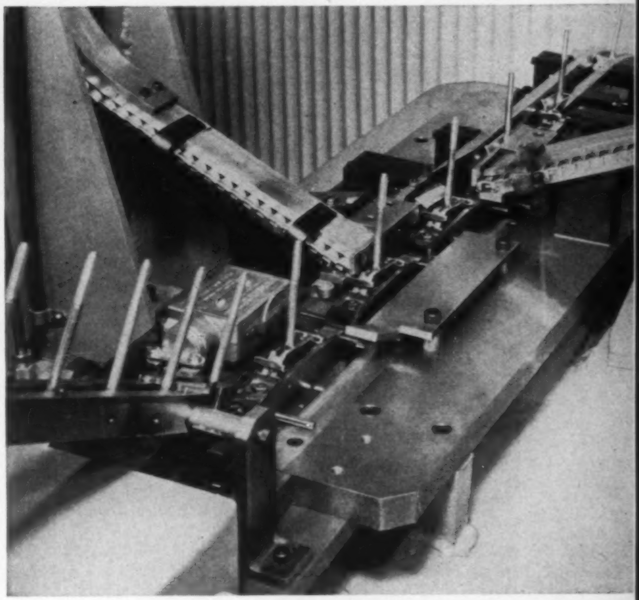
3

Diagram depicts assembly operations and parts flow in the second machine. This unit automatically assembles 30 completed razors per minute consisting of half-cap assemblies plus four other components.



4

Photo of the in-line subassembly machine. Spiders are manually loaded into the chute at rear, automatically escaped into fixtures which carry them past stations where the half-caps are inserted, and chuted out at front for loading into magazine trays.

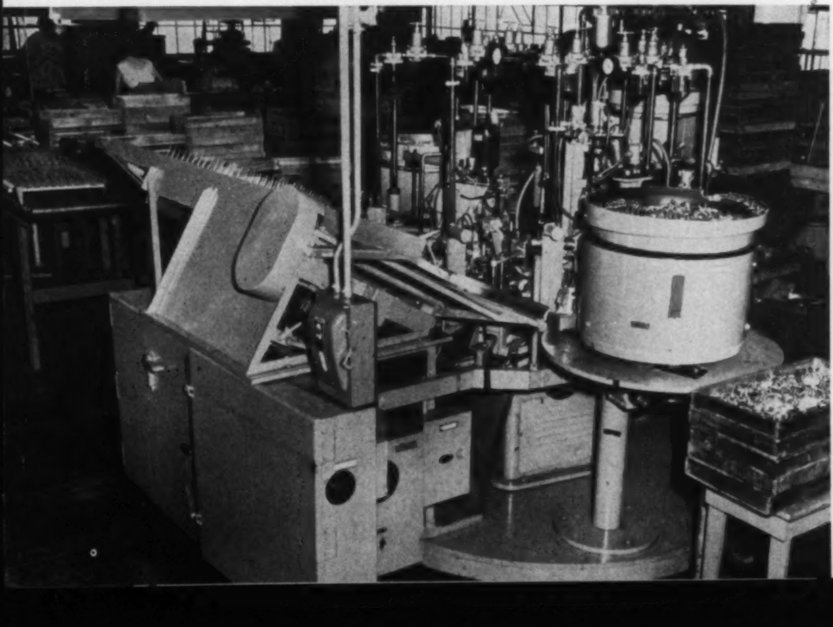


5

Closeup of subassembly machine shows chutes bringing half-caps from vibratory feeders to stations where they are inserted into arms on the spider. One half-cap is sprung into each side of the spider.

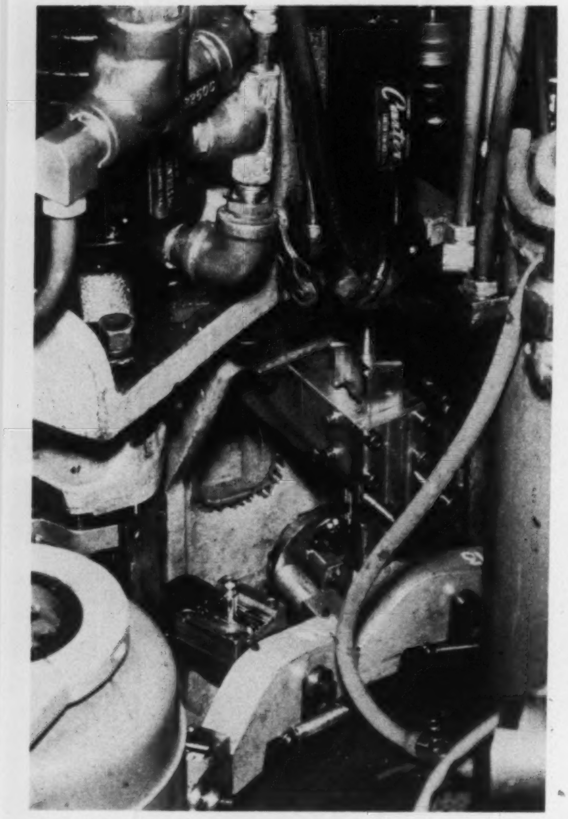
piece of equipment is a rotary indexing machine built around a standard Swanson chassis. Fixtures to hold the work are located on the perimeter of the indexing turret. There are 16 double fixtures, arranged so that there is an inner ring of 16 workholders and an outer ring of 16 holders. Heads to perform the necessary operations are mounted on pedestals outside the turret perimeter. Four vibratory bowl feeders are mounted with the operating heads to feed guard extensions, outer tubes, inner tubes, and screws. The half-cap assemblies are fed from the magazine trays which are filled at the subassembly machine. The trays are automatically indexed into position above a chute to maintain a flow of half-cap assemblies to the turret.

Most of the stations are air operated and electrically controlled. The moving elements at each station are automatically returned to at-rest positions on completion of the station's operating cycle. Failure of any of the stations to return to this position prevents the machine from indexing. Limit switches, ahead of stations where parts



6

Completed razors are assembled on this rotary turret machine built around a standard Swanson indexing chassis. Operating heads and automatic feeders are installed outside the turret perimeter. Parts are automatically fed and escaped to 16 double fixtures on the turret. Finished assemblies travel by belt conveyor to the inspectors in the background.



7

Guard extensions are fed from a vibratory feeder, escaped, and inserted into empty holders in an inner ring of fixtures on the turret. A pin in each fixture fits into a hole in the guard extension and holds the part in place.

are fed, check for the presence of other parts which should be in the fixture, and prevent feeding of new parts in the absence of prerequisite parts.

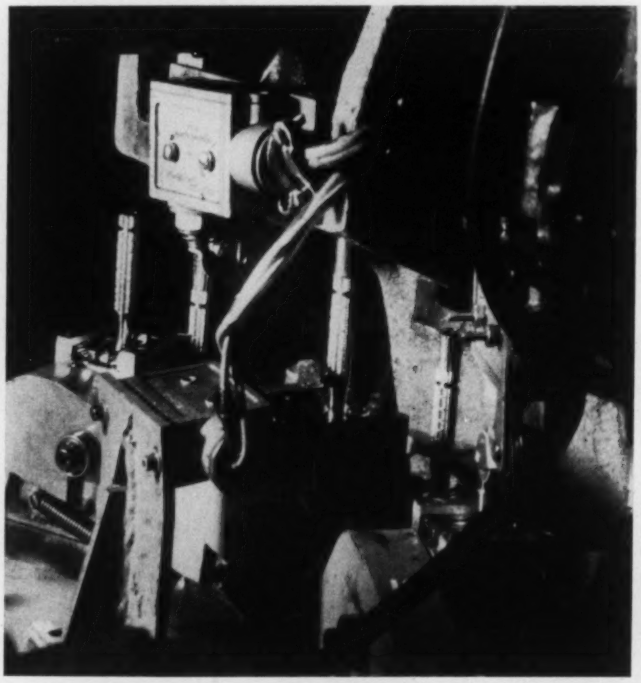
Operations on the second machine are as follows: Guard extensions are fed into the inner ring of fixtures; outer tubes are fed and pressed on; lubricant is applied to prevent galling during assembly of the inner tubes; inner tubes are fed and pressed past a retaining boss in the outer tubes; half-cap assemblies are fed into the outer ring of fixtures; guard and tube assemblies are lifted from the inner ring of fixtures and placed over the half-cap assemblies on the outer ring of fixtures; inner tubes are screwed down on external threads on the spider stems, closing the half caps; lugs are staked over on the spiders to retain them in the guard extensions; screws are fed into the inner tubes; the screws are run into internal threads in the spider stems to retain the inner tube on the spider stem; and the completed razors are unloaded onto a conveyor which carries them to inspection.

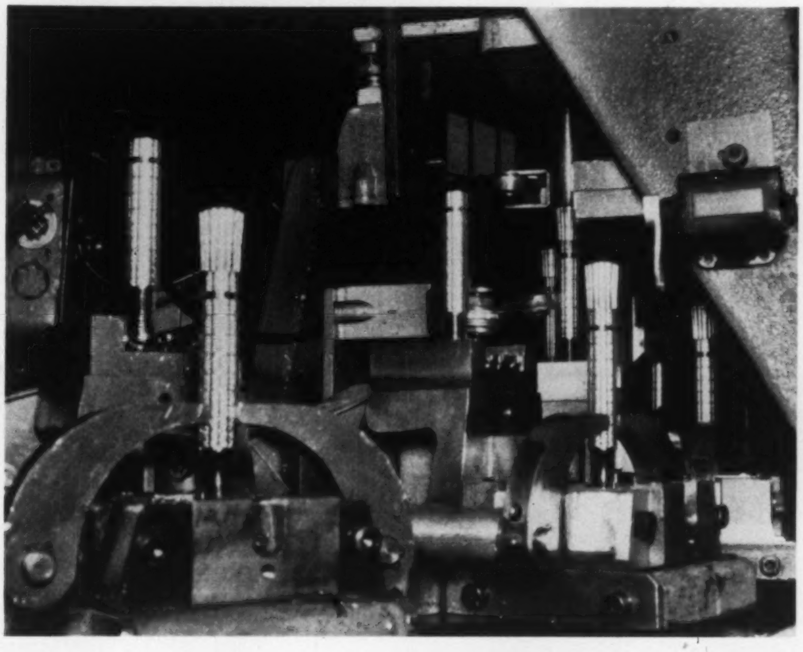
When Gillette engineers first gave serious thought to automatic assembly, they considered the idea of redesigning the razors to make the parts more adaptable to the new process. After some investigation they decided that no changes were necessary; nor were changes anticipated in the immediate future. This means that Gillette razors meet two prime requirements for automatic assembly: High volume production and design stability.

From the beginning the engineers at Gillette decided to give the assignment to specialists rather than design the special purpose machines themselves. Although no one had ever assembled a

8

Presence of the guard extension in an inner fixture is checked by the limit switch at right. In center the outer tube is being pressed onto the guard extension. The outer tubes are fed from a vibratory feeder and oriented for right end up by means of a photoelectric circuit checking the outside groove formed in rolling a projection inside the tube. If the tube comes from the feeder with grooved end down it is turned end-for-end to the right position. More fully assembled razors visible in the picture are traveling between operations on the outer ring of fixtures.





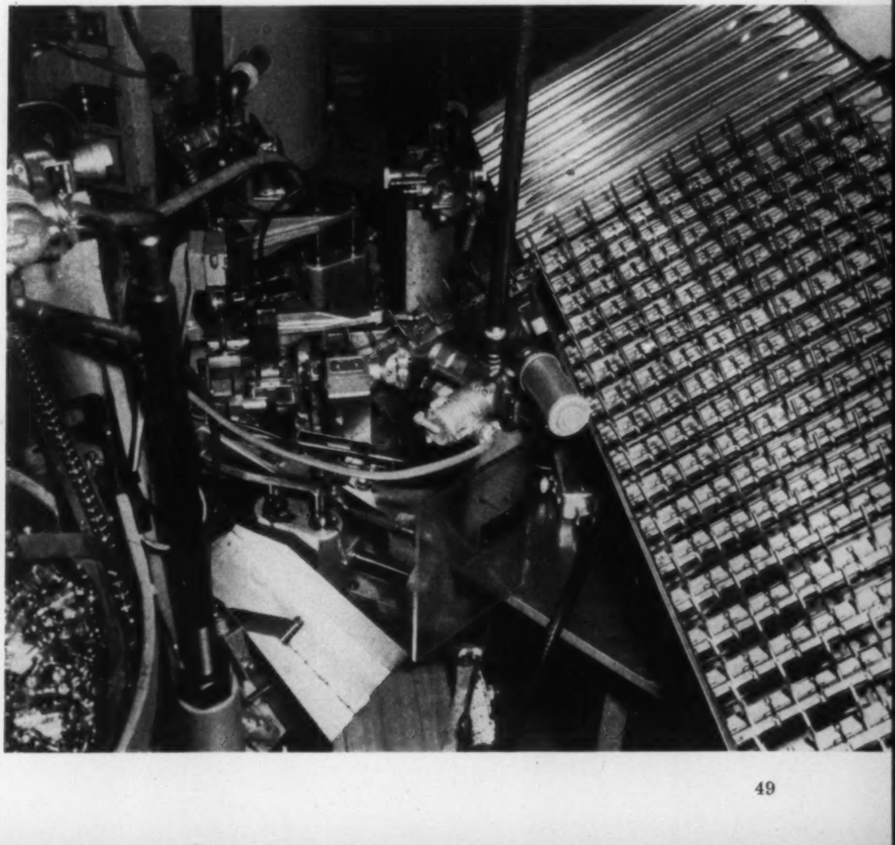
9

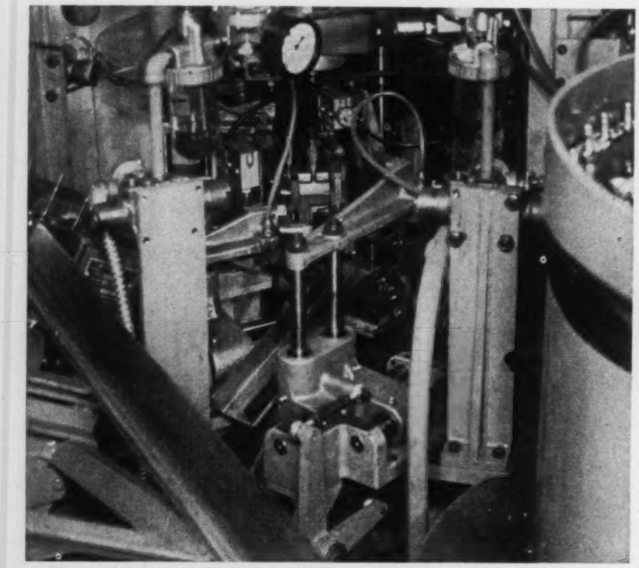
An oil wick is inserted into the outer tubes to prevent galling before this operation, in which ends of the inner tubes are forced past the rolled-in projection inside the outer tube. This rolled-in section retains the inner tube in the outer one but allows the inner tube to be rotated which, in the completed razor, opens and closes the half-caps for blade changing. This view also shows the clamping arrangement which holds the tube assembly after it is transferred to the lower, outer ring of fixtures.

safety razor by other than hand methods, they knew that a builder of special machines would have had experience in designing equipment for feeding, orienting and holding parts that were similar to some degree. After the problem was discussed with Swanson it was agreed that automated assembly was feasible. Gillette then authorized preliminary plans; the plans were approved; and an order was placed for the first machines.

10

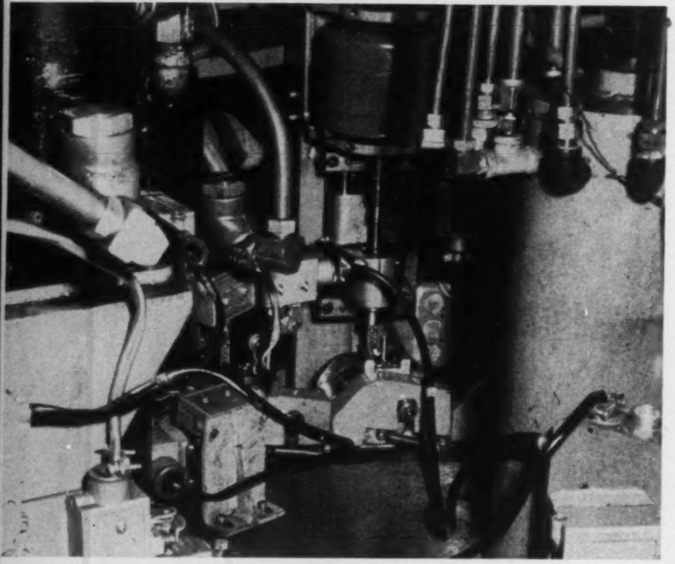
Half-cap assemblies are fed, escaped and inserted into the outer fixtures as shown in this photo. The magazine trays in which these assemblies come from the subassembly machine are automatically indexed to maintain the flow of these assemblies to the supply track. The head for lifting guard extension and tube assemblies from the inner circle of fixtures and depositing them over the half-cap assemblies on the outer fixtures is shown behind the half-cap assembly loading station. The chute at bottom center deposits the assembled razors on the conveyor belt after they complete the cycle around the turret on the outer fixtures.





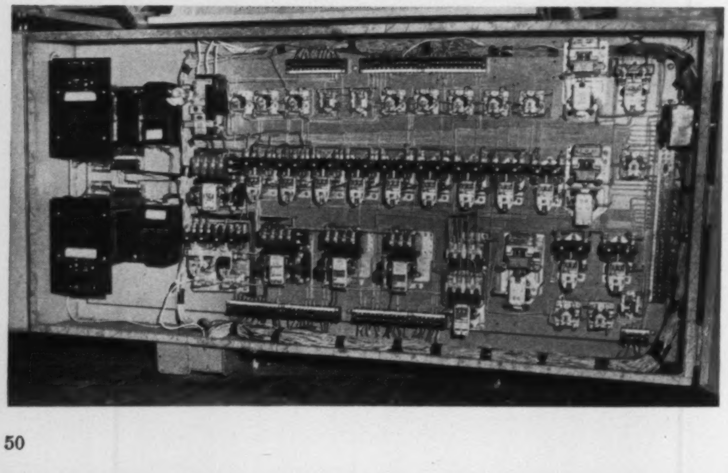
11

View from the opposite side of the head for transferring tube assemblies from the inner to the outer fixtures. Chute leading down to left disposes of rejected tube assemblies. The clamps which hold the tube assembly on the outer fixture are shown in their open position. In a subsequent operation the inner tube is screwed down on the spider stem by a spinner with a rubber friction pad which rotates the tube.



12

This photo shows the station at which a screw is run to a preset torque in the end of the spider stem. The screw is fed into the top of the inner tube at the preceding station. The screwdriver spindle incorporates a friction clutch which is set for the desired torque; when the screw is sufficiently tight, the clutch starts to slip; the motor current immediately increases; an electronic control senses the increase, and actuates a relay which causes the screwdriver to return to its at-rest position. Wear on the clutch is negligible since only slight slippage occurs. The completed razor then rides around to the station where it is ejected onto the belt conveyor.



13

Electrical control equipment for the rotary assembly machine is conveniently mounted under the tray feeder which handles the trays of halfcap assemblies.

ORGANIZING FOR AUTOMATION

—INTEGRATING TECHNICAL SPECIALIZATION

Historically, few companies have as much experience with automation as does A. O. Smith Corp. And what has a wealth of experience taught this company about automation? Paradoxically, a principle of primary importance has been identified which deals with men, how they are organized and their efforts co-ordinated.

By D. W. SHERMAN
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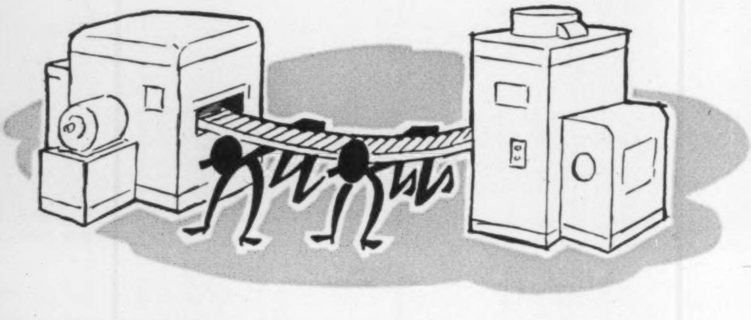
Milwaukee, Wis.

IN THE DEVELOPMENT of a physical article, from recognition of the need for the article to fulfillment of that need, a series of actions must take place within technical and mechanical areas. These include research, product design, testing, tool design, machinery design, plant layout, tool and machine tryout and adjustment, and so on. While the fact that these areas or fields are closely associated is commonly recognized, their great ability to influence each other to the benefit of the ultimate product and operation normally will not be fully appreciated except by one who, while having the broad objective in mind, has proceeded personally through all of these steps in developing a particular article.

Following conventional processing practices two or more concerns can produce like articles with quite different arrangements of machinery and facilities. Poor arrangements and concepts, as compared to an ideal, need not prevent the production of a usable article since operational ability can be achieved through the use of an excess amount of manual labor. Competitively, the cost of relatively poor processing practices in one case may be offset by more effective action in other areas, as for example in selling, so that the aforementioned weaknesses are not necessarily apparent. Such weaknesses may well be the result of poor co-ordination of the several fields or skills discussed in the preceding paragraph.

Highly automated factories producing like articles need not necessarily be arranged the same and employ exactly the same procedures. Because of mechanical limitations, however, they are liable to be much more alike than those less fully mechanized. Furthermore, the effect of poor concepts cannot be offset by adding manual labor without the fact being rather readily apparent. In fact, the poorly conceived automatic facility may not run at all. Thus the trend toward fuller mechanization of the industrial process may highlight weaknesses stemming from poor organization which have not been significantly apparent in the past. If weaknesses do become apparent, the advantages



. . . the effect of poor concepts cannot be offset by adding manual labor without the fact being rather readily apparent.

realized by the company when corrections are made may be fully as valuable as those contributed by machines.

▶ Importance of Integration

A most significant and common characteristic of automation is that of integration. The design of the product, the tools, the machines, and the handling equipment, must all be integrated to mesh together and perform in unison under the direction of suitable controls. The resulting entity is, in fact, a single integrated machine.

Recognizing now that machines and factories originate in the minds of men, and that development programs of any magnitude require the services of a plurality of persons embodying the necessary skills and technical capabilities, it seems evident that the excellence of any major automation program will be more or less in direct ratio to the integration of the minds of those charged with its execution. If we accept this as fact then we will certainly investigate the state of integration of the organization before committing a program of any size to its care and supervision, and we might investigate in any event since the need for such integration is not peculiar to automation principles but is merely highlighted thereby. Let us examine, then, organizational alignments in the typical industrial firm with specific reference to the technical and mechanical areas.

Quite commonly we will find that engineering's scope is that of product design—period. Research and testing may be a separate organization with its leadership at a level equal to that of engineering. The selection of processing methods, tool design, equipment design and selection, etc., may be a manufacturing function, again at equal level. However they may be cut and labeled, the significant fact is that these closely associated, in fact, intertwined functions are likely to be directed and led by several individuals without such leaders being closely supervised in turn by intimate qualified leadership.

Where such divided leadership exists we will not find the integration and close interplay needed for maximum results. In the first place no two individuals will see issues alike at all times, nor should they. Lack of singular leadership, therefore, will lead to division and compromise and will prevent the complete execution of a unified and singular thought concept. Secondly, each group will be preoccupied with its own problems, as any group should be, and will tend more toward finding fault with the other groups than to having sympathetic understanding of the overall problem. In designing tools, for example, the tool design group may well find considerable fault with the product designed by the product design group because of particularly difficult tooling problems encountered. But because the tool group is very busy, and because its members doubt that the product group would be sympathetic to a design change anyway, they will probably struggle through their particular problem if at all possible. Ordinarily a product change is requested by the tool group only when it finds itself unable to work out a practicable tool.

▶ Role of the Leader

A properly qualified singular leader, recognizing the inherent cleavage between such groups will guard against the evil by encouraging interplay, insisting upon it in fact, and by keeping suffi-

. . . it seems evident that the excellence of any major automation program will be more or less in direct ratio to the integration of the minds of those charged with its execution.

ciently abreast of the overall situation to permit himself to personally intercede in flagrant cases. He will gather together the group leaders at frequent intervals and run a searching investigation of the particular problems of each. He will then act to interpret for the entire group just what the individual problem can mean to the overall program and, in turn, to each participating individual. Finally, he will serve as a wise umpire where opinions differ.

With the increasing complexity of the technical picture we must look to more and more technical specialization if we are to have truly expert capabilities available. Thus we must encourage and insist upon specialization and provide the necessary environment. We must segregate, in other words, so as to create true experts rather than Jacks-of-all-trades. This runs counter, however, to the need for integration. Here again then the need for singular leadership and authority is predominantly evident. As the mechanic uses the particular specialized tool necessary to complete a particular portion of his task, so too will the qualified organizational leader use particular specialists at the right time, and only the right time, so as to complete a high quality singular end entity derived from the minds of specialists in many fields. And as the good mechanic sees to it that he has all the proper tools and that they are returned to their proper place when not in use, so too will the leader be sure he has specialized knowledge available in all of the necessary fields, and that such knowledge operates in its proper sphere at all times.

. . . he will gather together the group leaders . . . run a searching investigation . . . act to interpret what the individual problem can mean to the overall program and . . . will serve as a wise umpire where opinions differ.

A specific and all important premise presented for consideration then is that under any circumstances the inter-related technical and mechanical areas must have qualified singular leadership if best results are to be achieved, and that this will become a necessity as the trend toward automation increases.

▶ Value of Experience

From the standpoint of management, automation may well place a premium on engineering sense in the top echelons. The average engineer or technical person, being in fact a specialist, and properly so, will not ordinarily be conversant with all of the factors associated with the economics of programs requiring large investments. Perusal, study, and summarization of individual reports and proposals, however excellent in themselves, will not necessarily tell the entire story and may, in fact, be misleading.

Beyond this is needed a somewhat intuitive sense, based upon a feeling for mechanical things and an appreciation for natural laws, which may say "This program is a good one in the final analysis, even though the data do not entirely substantiate such a conclusion" or "This program is unsound even though the reports seem to spell success". A broad feeling of this sort can only be achieved by one who has spent many years in the engineering game in increasingly broader capacity, and who has seen and understood the reason for many successes and failures. Thus the management person having, say, a financial background, however competent, will not be able to formulate an entirely sound judgment on technical matters. He must recognize the type of background needed, therefore, and rest his decision on the basis of his confidence in a person rather than upon personal knowledge.

A further point for consideration is that the engineering balance needed in an organization competent to create large scale automation programs cannot ordinarily be utilized full time by an individual firm desiring automation but whose primary function is that of manufacturing. This might seem to herald the continued growth of engineering firms specializing in developing machines, processes, and factories on a contractual basis. Possibly so. That engineering firms of this sort can have the intimate knowledge of a company's needs, and the singleness of purpose required for maximum accomplishment and the development of unique and individualistic machines and processes, however, is questionable. More logically, engineering organizations might be developed as separate but controlled entities by the larger firms capable of doing so and requiring such services intermittently, with engineering services being made available to smaller firms during the interim periods.* Such action, while solving the problem for the large industrial firm, would serve a worthwhile purpose in assisting in the growth and effectiveness of smaller operations.

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*This article was prepared prior to November, 1956, when the A. O. Smith Corp. announced the formation of the A. O. Smith Engineering Service Corp. and the appointment of the author as president. He was previously executive staff engineer of A. O. Smith Corp. The new engineering company will supplement the engineering programs presently carried on by 12 operating divisions of the parent corporation and in addition its services will be available to other clients.

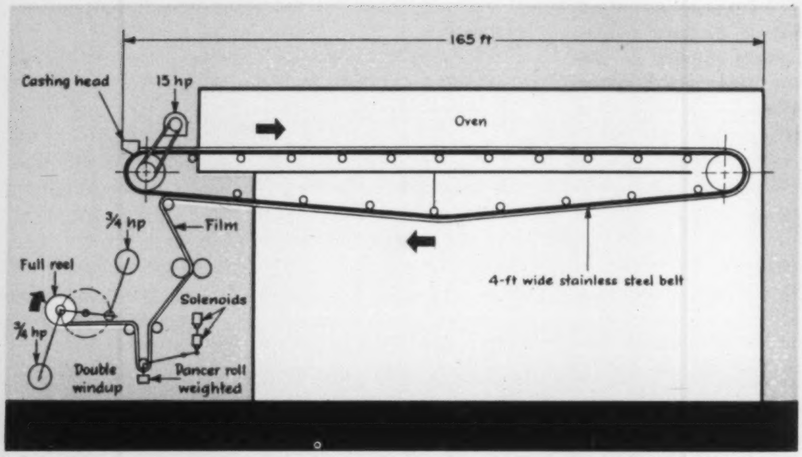

Fig. 1—Schematic diagram of Koroseal film casting machine. Liquid Koroseal is deposited on the moving belt at the casting head, solvents vaporized in the oven, and plastic film stripped from the belt, slit and rolled automatically.

REGULATORS AT WORK

Proper selection of regulating systems for individual applications is the key to improved performance efficiency which affects product quality, quantity and economy of equipment cost. The author illustrates this axiom by presenting several successful accomplishments in continuous processing.

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Machine and Electronic Applications
Development Dept.
The B. F. Goodrich Co.

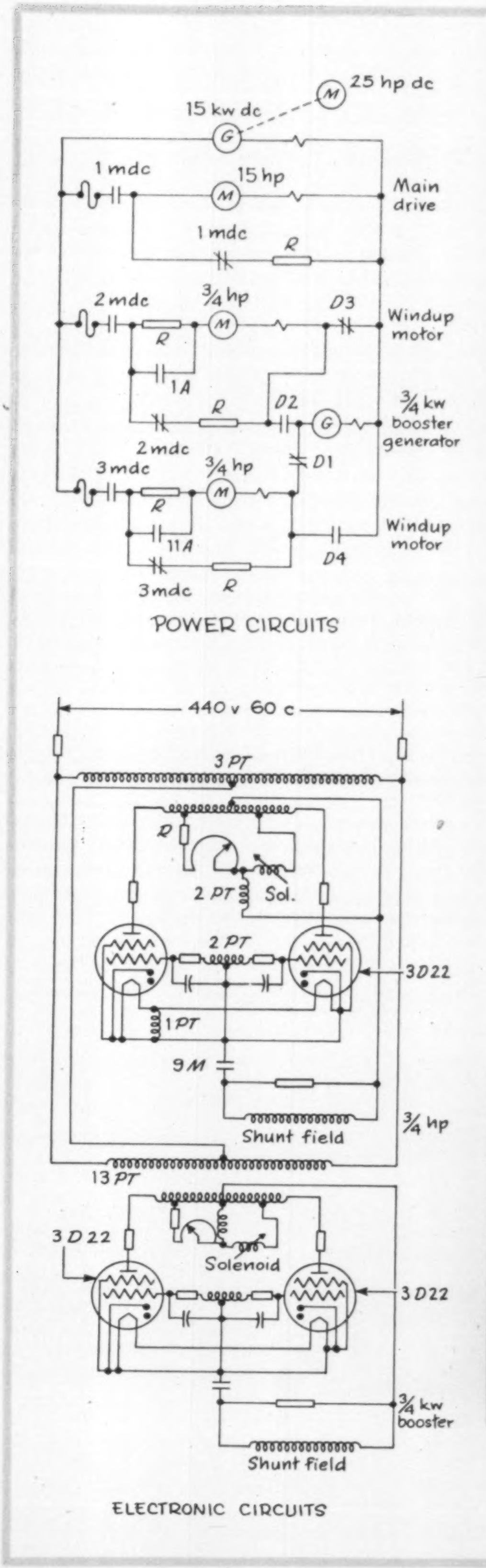
PRODUCTION RECORDS in the rubber manufacturing industries and plastics plants are breaking all previous factory output attainments. This ability to increase production efficiently is due largely to the development and improvements in the art of automatic regulator design.

In order to successfully apply regulating equipment, it is imperative to have a thorough understanding of the process involved and the factors affecting product quality, quantity and economy of equipment costs. No less thorough an understanding of regulating equipment and its application to the process is required.

▶ Sense and Control

Fundamentally, an automatic regulating system is a control system which senses the existing drive conditions and automatically corrects any difference between the desired and actual load conditions through feedback signals in closed loop control circuits. A portion of the output is fed back to an error-sensing device. This feedback signal from the output opposes a standard or reference signal and the difference is the error signal. This error signal is fed into an amplifier to control, for example, generator shunt field excitation by grid control of tube rectifiers, or whatever the controlling element might be, making the necessary correction to bring the drive system into equilibrium. When the feedback signal equals the reference signal, the error signal is zero and the control system will be at rest with no corrective action taking place.

Two general types of feedback systems are in common use, the relay system and the continuous system. The relay system has a dead band where the control is inactive and can apply control only in two modes outside of the dead band such as in a limit switch control with a *Start* limit switch and a *Stop* limit switch. The relay system is not very satisfactory where high accuracy is required. Full power *On* or *Off* is actuated by the limit switches even when only a small error is to be corrected. The continuous feedback system is by far the most important. In this system the correcting effort is proportional to the error, permitting smoother operation without a dead or noncorrect-


25 hp dc
15 kw dc
1 mdc
15 hp
Main drive
1 mdc
R
2 mdc
3/4 hp
D3
Windup motor
R
1A
R
D2
3/4 kw booster generator
2 mdc
3 mdc
3/4 hp
D1
R
11A
Windup motor
D4
3 mdc
R
440 v 60 c
3 PT
R
2 PT
Sol.
2 PT
3D22
1 PT
9M
Shunt field
3/4 hp
13 PT
3D22
Solenoid
3D22
3/4 kw booster
Shunt field

POWER CIRCUITS

ELECTRONIC CIRCUITS

ing band. This results in greater accuracy and better speed of response of the system.

▶ Question of Selection

Selection of the proper type of regulating system for the job is of primary importance. Some of the questions which arise when the user is about to select automatic regulating equipment are:

What types of automatic regulator systems are available? There are hydraulic, pneumatic, mechanical and electrical regulating systems available. Since electric motors are in universal use and can be controlled from a wide variety and type of signals, the electrical regulating system is prominent as a controlling medium. Better control at less cost is the deciding factor among the four types of regulating equipment.

What types of electrical regulating systems are available? Large power amplification and fast response of rotating regulators, such as Amplidynes and dc generators, booster generators, etc. provide excellent operating characteristics for many applications. Magnetic amplifier regulators are static device control elements. When the core is saturated, the impedance of the output winding is practically zero, allowing high direct current to flow to the load through rectifiers. With no moving components, these rugged, reliable units give long trouble-free life. For most industrial applications, the response time (3 cycles) is quite sufficient. Formerly magnetic amplifiers were used mostly on shunt field control applications carrying small currents. Today, large armature current power magnetic amplifiers are finding a definite place in the regulator field. No moving parts or rotating equipment are necessary for adjustable voltage control over 20 to 1 speed range. Simplified circuits, reliability, minimum equipment, fast response

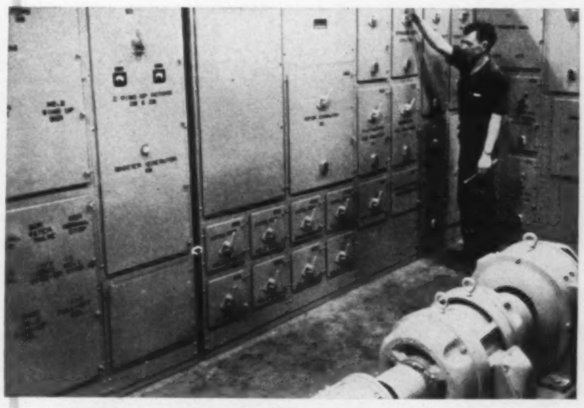


Fig. 2—Power and electronic control circuits for main drive and double windup motors. Also shown is the control cubicle for the Koroseal film casting system. All electrical equipment at the machine is explosion-proof and the motor-generator booster-exciter unit and control cubicles are isolated in standard enclosures.

with practically no maintenance are outstanding features, while the cost is less than several other types of regulators. Rotating and magnetic amplifier regulators are generally considered more reliable than electronic regulators. However, electronic equipment is noted for greater accuracy and faster speed of response. On small processing drives, electronic equipment is usually less expensive. Control cost must be balanced against machine performance.

Application requirements of drive control systems regarding limits and tolerances should be analyzed to determine:

1. Tension required and tolerance permissible.
2. Speed in rpm or fpm and tolerance.
3. Operating speed range required (3 to 1, 5 to 1, 10 to 1, etc.).
4. Accuracy required at maximum and minimum speeds.
5. Acceleration required, deceleration required, current limiting values.
6. Type of loading over wide speed range(impact loading, oscillating load, etc.).
7. Response time required.

In specifying limitations and tolerances of automatic regulators, it is of utmost importance to completely analyze the drive problem and to demand only tolerances actually required, rather than specify extreme accuracies which may not be necessary. Accuracies of 3 to 5 per cent may be satisfactory in many cases. However, if 0.1 per cent accuracy is requested, equipment cost may be 4 to 5 times the cost of more usual equipment. It may be necessary to consult the product technical division to determine limitations and tolerances allowable in processing the material. With this information, the most practical type of equipment can be provided to give optimum overall results.

Proof of the Pudding—Applications

Perhaps the most satisfactory way to demonstrate the usage of regulators in continuous processing systems is to examine several typical installations. The first application consists of a constant tension and speed regulating system, on a Koroseal film casting machine, *Fig.* 1. A casting head deposits liquid Koroseal at room temperature on the 4-foot wide stainless steel belt. As the liquid on the belt enters the first oven zone, the 165F oven temperature vaporizes the methyl-ethyl-ketone solvent and the solids remain on the casting belt in the form of plastic film. The machine film-thickness capacity varies from 0.0008-inch to 0.0025-inch. The finished cast film is stripped from the belt, slit and passed through a dancer roll loop control to the double windup roll unit.

A 15 hp, dc motor drives the stainless steel belt 5 fpm during threading operation, then by voltage control, through an adjustable speed range, to the normal operating speed of 120 fpm. This covers a 24 to 1 operating speed range. A 15 kw motor-generator furnishes adjustable dc voltage to the drive units, *Fig.* 2. A pushbutton operated, motor driven rheostat controls the generator shunt field and the generator output. Two film windup motors, $\frac{3}{4}$ hp, 600/2400 rpm, 230 volt dc, automatically running one at a time, also receive power from the motor-generator set. A $\frac{3}{4}$ kw booster generator is connected in series with whichever windup motor is operating, supplying *IR* drop compensation to the windup motor in the low speed range. Since the windup roll increases in effective diameter by a multiple of greater than 3,

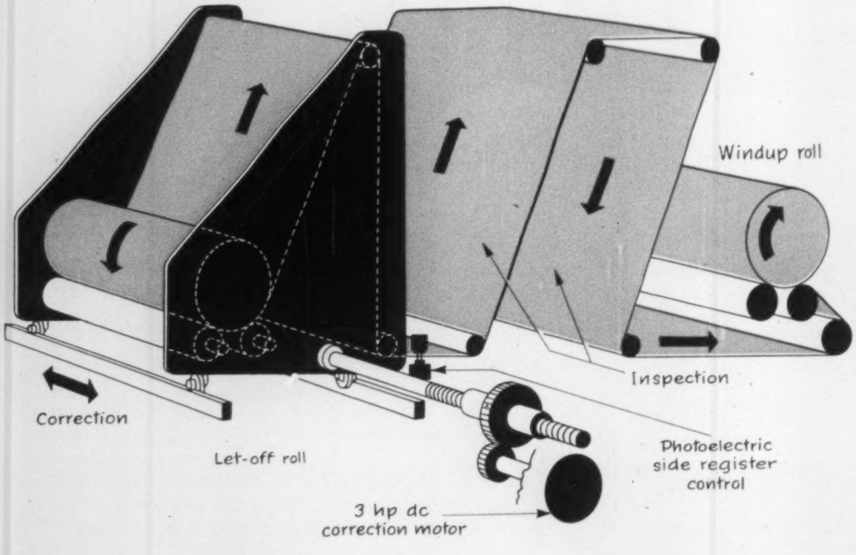


Fig. 3—Side register control in a fabric let-off and wind-up system for fabric inspection. A photocell senses the edge position and correction is accomplished by moving the let-off roll axially.

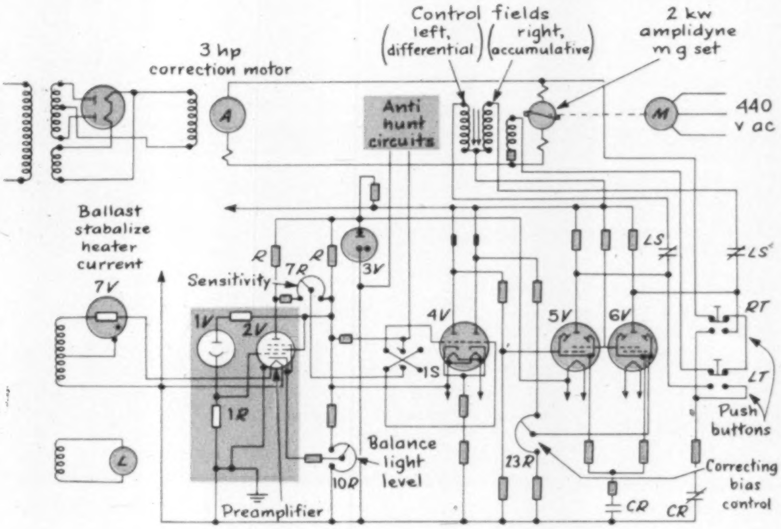


Fig. 4—Amplidyne and electronic controls for automatic side register regulation. When the fabric edge is in proper position, the edge is in the center of the light beam over the phototube, and half of the light is received by the phototube causing current to flow through phototube 1V and through 1R resistor. The voltage drops when 1R operates pre-amplifier tube 2V which is coupled to a balanced amplifier tube 4V through sensitivity potentiometer 7R and sense-reversing switch 1S. Tube 4V amplifies and phase inverts the signals from pre-amplifier 2V. Therefore, when the stock edge is in the center of the light beam, the two signals from tube 4V are equal and opposite. These signals are applied to the grids of tubes 5V and 6V. The anode or output currents of 5V and 6V are also equal but flow in opposite directions through the two Amplidyne-generator control fields.

the windup motor must be capable of operating over a 72 to 1 speed range.

The floating dancer roll is weighted to give a known constant tension in the film throughout the entire speed range. Automatic speed regulation is obtained by the dancer roll positioning two solenoid reactor cores. Each reactor operates separately in its own thyratron rectifier tube circuit. One reactor strengthens the windup-motor shunt field to slow the motor as the windup film roll increases in diameter. Simultaneously the second reactor strengthens the booster generator shunt field as the windup motor slows, thereby increasing the booster generator output voltage at very slow windup motor speeds.

Practically full torque on the windup motor is maintained over the 72 to 1 speed range. A double roll windup with two motors, one motor on each windup, is used and an automatic roll change, (manually started), is made without stopping the film casting machine.

▶ Stock Edge Position Regulator

A belt fabric inspection machine using electronically controlled Amplidyne and photo-electric side-register control is shown in *Fig.* 3. During inspection of belt fabric material, a 3 hp, dc reversing correction motor drives a screw which moves the fabric let-off roll back and forth automatically, being controlled by a photoelectric beam on the edge of the stock. When the let-off stock roll is in proper position, the stock edge is in the center of the light beam over the phototube. At this time, when both left and right control fields are energized in equal amounts, *Fig.* 4, the output voltage of the Amplidyne is zero and the correction motor is at standstill. When the fabric stock edge moves away from the phototube, more light enters the phototube, resulting in a larger voltage across *1R*. This signal is amplified in tube *2V*, and again is coupled to tube *4V*, giving it two signals, one large and one small, which are amplified and phase inverted. Each of the two signals are passed on to tubes *5V* and *6V*. Current through one tube increases, and decreases in the other tube. The outputs are connected to their respective Amplidyne control fields, (left and right). The strong signal voltage dominates in the Amplidyne, thereby setting up an output voltage giving a polarity as called for by the control fields. The correction motor receives this voltage and brings the let-off roll stock edge back into the center position of the phototube again.

Excellent results have been obtained with this side-register control. The accuracy of the control depends largely upon the machine components. A high degree of accuracy is possible only when backlash and play have been reduced to a minimum in the machine mechanisms. For greatest machine accuracy the correction motor should be geared to the correcting mechanism so that the correction rate at the motor base-speed will be at least twice the material run-out rate.

▶ Speed Matching of Motors

A tread making unit, *Fig.* 5, uses motor-generator variable voltage and magnetic amplifier motor field control for speed matching of conveyors and roll drives. Tire treads are continuously extruded and passed through 11 processing operations automatically except for final cementing of tread ends and placing cut treads in trucks.

The automatic electrical control, *Fig.* 6, consists of a motor-generator supplying the same armature voltage to 8 conveyor and roll drive motors in the train, in addition to speed synchronizing controls operated by dancer rolls riding the tread loops between conveyors and rolls. Each

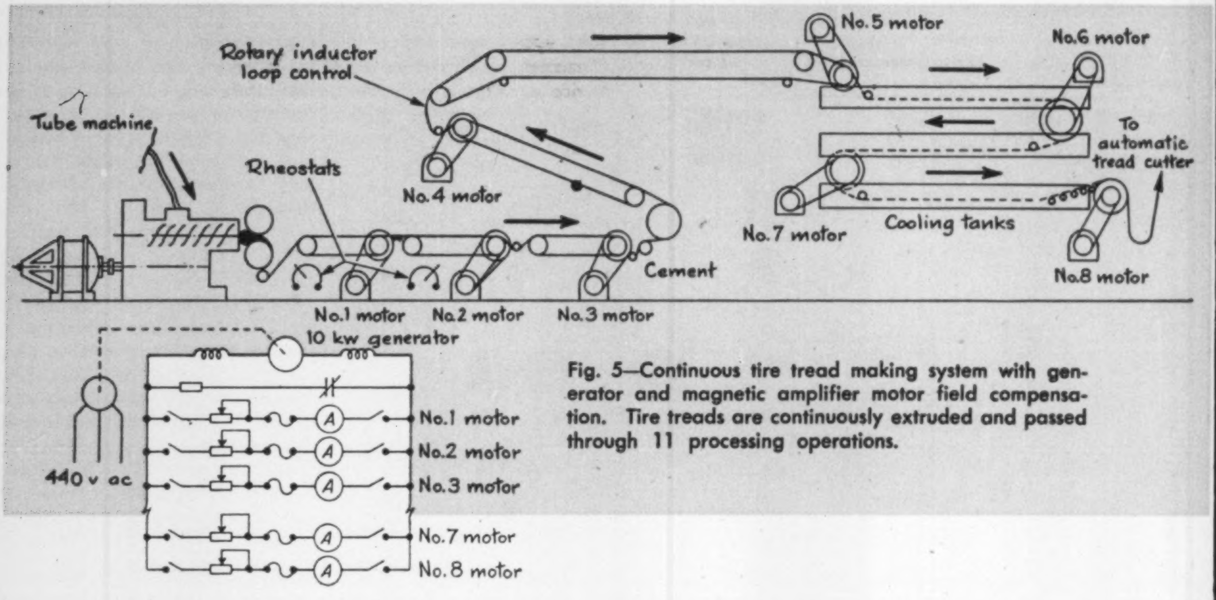


Fig. 5—Continuous tire tread making system with generator and magnetic amplifier motor field compensation. Tire treads are continuously extruded and passed through 11 processing operations.

dancer roll operates a rotary inductor, (variable transformer), which controls the position winding in the magnetic amplifier. Output of the 6 magnetic amplifiers furnishes current to the shunt fields of the 6 corresponding dc drive motors, speeding or slowing them to speed-match the conveyor on each side of the loop control. The operator sets the generator field rheostat, (for coarse speed adjustment), corresponding to the size tread to be run (6 to 8 tread sizes or more can be run with the same rheostat setting). All 8 motors then run approximately at a corresponding speed. The loop control between conveyors, connected to rotary inductors, operating magnetic amplifiers, automatically does the fine speed adjustment.

The first two conveyors have manual rheostats which the operator presets for the desired tread shrinking, stretching, gage and weight control. Number one conveyor rheostat is set midway in its range. All remaining seven motors will then also operate near their midway speed range for that particular armature voltage. All 6 automatically controlled motors can then increase or reduce speed as required to maintain equilibrium in the train of drives.

Number three conveyor, a continuous weighing scale, is the first magnetic amplifier controlled belt. After the gage, width and weight have been set, the tread continues automatically through cementing, drying, overhead conveyors and three water cooling tanks. The last motor in the line takes the tread from the cooling tanks to the automatic tread cutter.

Load balancing adjustable resistors are connected in series with each motor armature. Since several different sizes of dc motors are in the line, the series resistors are adjusted to equalize the armature circuit resistance drops, which help to maintain division of load over the operating speed range. With constant I_aR_a voltage drops, the back emf's keep all motor speeds synchronized.

Movement of the loop control arm between conveyors operates the rotary inductor through 40 degrees. The rotary output is connected to full wave selenium rectifiers furnishing a dc voltage to the position winding on the magnetic amplifier. As the loop arm is lowered, more current flows to the position winding. Increasing the position winding current reduces the output power of the magnetic amplifier, thereby speeding the drive motor. The bias winding (negative ampere turns) receives a constant dc voltage, and is set to raise the output of the magnetic amplifier to 260 volts dc. Two ac output windings on the magnetic amplifier feed through self-saturating rectifiers. This output is connected to full-wave output rectifiers and to the shunt field.

In addition to magnetic amplifier motor field control with armature voltage control from a motor-generator, some work is being done with a series booster magnetic amplifier in series with the motor armature. The movement of the rotary inductor controlled armature voltage provides the speed range. This system is simple and rugged with almost no moving parts. Long, maintenance-free performance is seen for this type of control.

▶ Installation Conversion

Earlier tread making units had four dc motors in the train, each 4 to 1 speed range by field control, using solenoid reactors operated from dancer rolls in the tread loops between conveyors. The solenoid, in a phase-shift circuit, operated two grid controlled thyratron tubes which fed rectified full wave dc to the shunt field of the controlled dc motor. Motor sizes varied from ¼ to 3 hp. Armature voltage was supplied from constant potential 230v factory dc.

Due to the wide range of field control available, the old motor drives were not as stable in speed as our later type tread unit drives. Recently, one of our old tread units was brought up-to-date by installing 4 additional drives and rewiring the present 4-motor electronic panel. A five-unit electronic panel was procured from an outside plant, a motor-generator from another plant, a power transformer from still another plant. These four major components were all interwired together. The four new drives were ½ to 1 hp constant speed motors while the 4 old motors, 4 to 1 speed range by field control, had pulley ratios changed in order to make the motor base speed provide the highest belt or roll surface speed. The constant potential 230 volt shop dc was disconnected and all motor armatures connected to the generator output terminals. Six motor shunt fields are now energized from thyratron tubes, *Fig.* 7, which are controlled from the solenoid loop arm riding on tread loops between conveyors. All motor series fields are disconnected. A generator field rheostat is set by the operator to run all 8 motors at approximately the correct speed. The individual solenoid loop controls then make speed adjustments to each conveyor, compensating for tread shrinkage variations, to match all corresponding drive speeds. During normal tread unit operation, the surface speed of the last roll (Number 8) is 19 per cent less than Number 1 belt surface speed. Drive ratios can be designed to gradually taper in output speed to more nearly match each belt speed (inches per minute) with the actual tread speed. In a 10 to 1 operating speed range by the variable voltage system, each individual drive runs at its midpoint position of field control.

When the complete unit is ready for test runs, the upper and lower limits of each field controlled motor speed can be set with the bias potentiometer in the phase-shift circuit of the thyratrons. Adjusting the bias potentiometer changes the field voltage over a wide range (about 65 per cent), when the solenoid plunger is completely *Out*. When the plunger is *In*, the same adjustments vary the weak field only 6½ per cent. The field voltage change, whether the plunger is *Out* or *In*, is always in the same direction when the bias potentiometer is adjusted.

If a 5000 ohm potentiometer is connected in parallel with the solenoid terminals of the 4 to 1 speed motor controls, the wide range of field voltage change (43½ per cent), occurs when the plunger is in the *In* position as the bias potentiometer is turned. When the plunger is in the *Out* position, field voltage only varies 5 per cent when the bias potentiometer is adjusted. In this manner full field voltage for slow speed with full torque is maintained, while the extreme low field voltage can be raised to limit the speed range and eliminate hunting. With these adjustments, the automatic field control can be set so that all motors, whether constant or adjustable speed, ¼ hp to 3 hp, will maintain stability and run together exceptionally well with almost no strain on the motors.

The main contactor in the generator field and generator output circuits always opens when the unit is stopped. In this manner, the dc drive motors can stay across the line when starting, since the generator voltage always goes to zero when stopping. When starting, the generator builds up from zero, thereby giving the drive motors a smooth start.

Should the operator not know what generator voltage to use for a certain size tread, a gage mark is scribed on the solenoid movement arm on the loop control most visible to the operator. If the indicator is above the gage mark, the operator reduces the generator voltage 10 volts. If

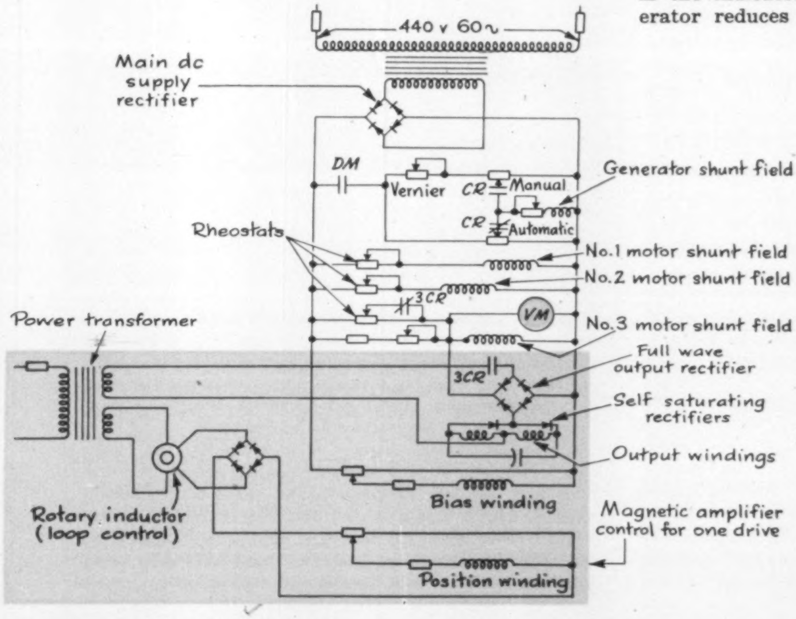


Fig. 6 — Magnetic amplifier motor speed matching control for tire tread making machine. The same armature voltage is supplied to eight conveyor and roll drive motors, and speed synchronizing controls.

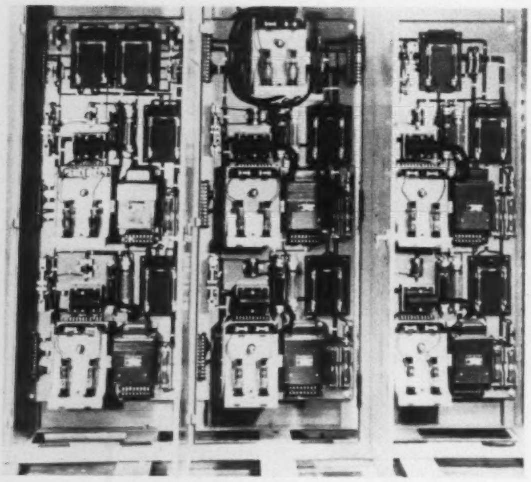


Fig. 7—Electronic panel for six motor speed matching controls. Motor shunt fields are energized from thyratron tubes which are controlled from a solenoid loop arm riding on tread loops between conveyors.

another correction is required, the generator voltage is again dropped 10 volts. If the indicator is below the gage mark, the operator raises the voltage 10 volts, until indicator and gage marks coincide. A number of sizes of treads can be run without changing the generator voltage.

Improvement Opportunities

In reviewing the most efficient manufacturing methods, the continuous processing applications have usually been proved to be superior. Whenever material being processed can travel at a uniform rate, as in the above illustrations, an opportunity arises to apply automatic electrical regulating control, which in turn will improve product quality and increase output at reduced unit cost. Since the automatic regulating system is "a natural" for achieving these benefits, it is apparent that this control has a definite place in the present and future of our industrial progress.

This article is based on a paper presented before the AIEE Rubber and Plastics Subcommittee Technical Conference in Akron, Ohio, April, 1956.

Assembling Small Motor Frames

INCREASING INTEREST in automatic operations has led to an increased demand for electric motors of all sizes. Satisfying this increased demand, motor manufacturers are, in turn, relying on automatic production equipment to a greater extent than previously. A recent example of equipment being used is a motor and stator core welder developed by the Cayuga Machine & Fabricating Co. Inc., Depew, N. Y. The machine is designed to handle small motor frames (sizes 56 and 66) at the rate of 500 units per hour; other frame sizes can be accommodated by changing the fixtures.

The automatic welder is built around a circular four-station indexing table. The motor core is placed on an expanding mandrel at the loading station and clamped into position. A prerolled frame is automatically wrapped around the core, clamped, and a welding back-up positioned. The machine then indexes to the second station where the ends of the rolled frame are welded with automatic inert gas welding equipment supplied by Westinghouse Electric Corp. Concurrently with the welding, a hole is drilled through the frame into the core. At the completion of the welding cycle, the welding head, the drill and outboard back-up retract automatically and the table indexes to the third station. At this station a chamfered pin is pressed into the frame and core hole, locking the two together. The table then indexes to the last station where the frame and core assembly is ejected.

The machine contains several interesting features: For example, two main control panels contain the electrical components for sequencing control. The panel for all the

sequenced operations on the rotating table is mounted on the table and rotates with it. Electrical power connections to this panel consist of a 110v single-phase supply line carried through the table spindle and connected to the rotating panel through motor type slip rings.

The panel for all sequencing operations on the stationary portion of the machine is mounted separately on the rear of the equipment.

Stations are interlocked such that the machine will cycle but not weld if the workpieces are not in position. The second and third stations are interlocked so that the welding head and drill head carriage retraction at Station 2 and the pneumatic press retraction at Station 3 must have taken place before the table can index.

A pedestal column support is provided for the beam-type travel carriage and welding head. An air cylinder with oilers and hydrochecks gives smooth speed control of the carriage, with a rate of travel that ranges from 20 to 120 inches per minute. All bearings, drill chuck, and other critical exposed parts are protected from weld splatter by accordion boots or other protective devices.

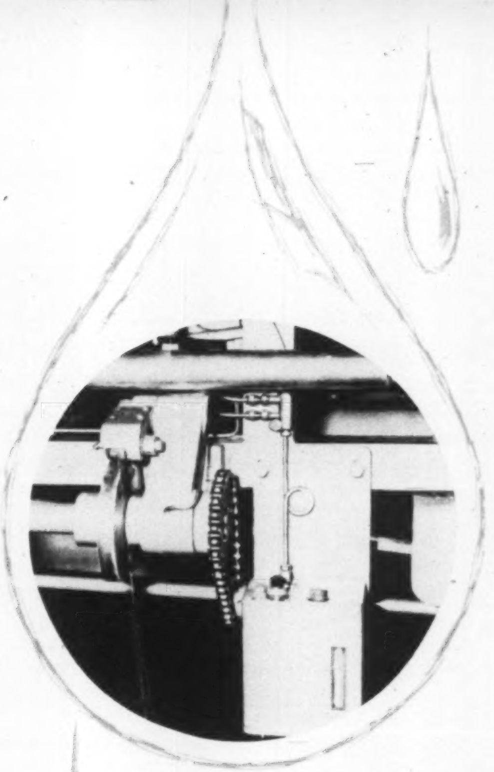


Fig. 1—Bacon wrapping machine, which wraps as many as 80 packages a minute in a variety of package shapes and sizes, incorporates an automatic lubricating system. The Bijur lubricator shown is driven directly from the machine and contains its own reservoir.

Increasing industrial dependence on high speed automated machines to get out the products demands adequate lubrication with a minimum of downtime for maintenance. Automatic lubricating systems help meet this need. This article covers packaging field applications which illustrate some of the general considerations.

MAINTENANCE IMPROVES WITH AUTOMATIC LUBRICATION

By W. O. WRIGHT
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Bijur Lubricating Corp.
Rochelle Park, N.J.

A KEY TREND in industry today is the steadily increasing use of automatic lubrication equipment on all types of high-speed automatic machinery. It is reducing maintenance manpower requirements by thousands of man-hours a year at some installations. It is reducing or eliminating parts replacement costs and product spoilage. It is keeping machinery running smoothly in large-scale production operations, where continuous 24-hour production is essential. In every case it is the only way a really adequate lubrication job can be performed.

In the packaging industry this trend is due to the tremendous expansion of all phases of the industry in the past ten years; the influx of automatic equipment, the combining of operations, the increasing use of new packaging materials, the doubling or tripling of packaging rates and the tremendous development of consumer product packaging. Each of these has created machinery of ever-increasing complexity—machinery that presents greater and greater maintenance problems.

▸ Lubrication Problems

A survey of automatic lubrication on packaging machinery reveals that certain general problems are common to a great many different types of equipment. The problems may vary in particulars, depending on the size and complexity of the machinery and the nature of the product being handled. But the following problems seem prevalent and pertinent to the industry in general.

Complex automatic machinery means more surfaces to lubricate—Today's major trends in industrial machinery—automation and higher production rates—applied to modern packaging machines account for their increasing complexity. As machine design becomes more intricate the problem of lubrication maintenance becomes more acute. Many packaging machines now serviced by automatic lubricators have over 200 bearings. Experience has proved to the manufacturer and user that it is impossible for any maintenance team to accomplish adequate manual lubrication on such

Some Automatic Lubrication Applications

TYPE OF MACHINE	MANUFACTURER	JOB PERFORMED	NO. OF POINTS AUTOMATICALLY LUBRICATED	KEY PARTS SERVICED BY AUTOMATIC LUBRICATING SYSTEM
Fillers and Sealers for plastic or metal tubes, bottles, jars	A & M Tool & Die Co., Inc.	Fills & Seals 120 tubes per minute with Double Fill, from 2 cc to 7 oz. range	10-24	Main drive bearings and slides—1 cc of oil distributed every 15 minutes. Guide rod bearings—2cc of oil distributed twice a day
Frozen food wrapper	Battle Creek Packaging Machines Co., & Package Machinery Co.	Wrap up to 175 packages per minute, in 9, 10 or 12 oz. sizes	75-110, depending on machine model	Main drive shaft, elevator assembly, infeed, paper feed, belt discharge unit
Flat top beer can filler	Crown Cork & Seal Co.	Fills over 400 beer cans per minute	70-80	"Continuous"—gears, cams, 30 followers, "Cyclic"—bearings, chains, gears, "Jet"—30 lift cylinders
Automatic cartoner	Dacam Corp.	Packs up to 750 cans per minute in 6 or 8 can cartons	45	2.5 cc of oil distributed every 18 minutes to slides, helical gears, chain drives, glue applicator bearings
Automatic bacon wrapper	The Globe Company	Wraps up to 80 packages of bacon per minute, in either ½ or 1 lb. units	46	Reel bearings, folder plates, paper feed mechanism, pusher rocker arm, knife arm bearings
Rotary vacuum bottle filler	International Filling Machine Corp.	Fills up to 400 cans or bottles per minute, from few ounces to 1 gallon	15	Rotary filling mechanism, bottom support bearings
Heat seal tea bag maker	Pneumatic Scale	Fills, seals, tags and stacks up to 180 tea bags per minute	210	Hopper section, main drives for bagger, tagger, stacker; all cams, slides, gears, etc.
Automatic lollipop formers	Sweets Co. of Amer. Inc.	Automatically forms 425 lollipops per minute	5	5 cam bearings in forming element of machine
Automatic lollipop wrappers	Package Machinery Co.	Automatically wraps 450 lollipops per minute	37	All main drive and transfer element bearings, slides, etc.

equipment with any degree of accuracy or necessary frequency.

Bearings hard to get at—Many of the lubrication points on a large packaging machine are inaccessible to manual lubrication. Often the working parts of the machine are enclosed, for the sake of safety or appearance. To reach these concealed lubrication points the maintenance man may have to crawl under, over or around other parts of the machine, or partially dismantle it, to apply the lubricant. Add to these problems the difficulty of finding all the oil cups or grease nipples on a large machine and the limited time a maintenance man has to devote to any one machine, and you have a clear picture of the inadequacy of manual lubrication methods on most packaging machines.

Too much or too little oil—How much oil does a bearing need? This is actually two questions: How much oil does a bearing need to function properly, and how often should it receive this quantity of oil? Both questions depend on the size and type of bearing, the amount of stress and load to which it is subjected, operating speed and the environment in which it operates. All large machines today incorporate a variety of bearing applications, with each application having its own lubrication requirements.

Even assuming that every bearing on a machine is serviced daily, the oil can and grease gun give no assurance that each bearing gets the amount of lubricant it needs. A large high-speed drive shaft may require a shot of oil every few minutes for maximum protection. A small bearing may need only one drop of oil every hour or so. In neither case will a daily squirt from an oil can or a charge of grease from a grease gun give the bearing correct lubrication.

What happens? A bearing may be overlubricated and drip oil. If this falls on an edible product, the product is spoiled and unfit for consumption. If it falls on a package, the wrapper may be stained and can't be marketed as a first-class item. Conversely, the bearing may receive too little oil. It will eventually freeze or burn out, the machine is stopped, and production is halted. This leads to unnecessary expense: Hours of lost production during downtime for machine repair; replacement parts; man-hours for dismantling and installation; and in some cases spoilage of a perishable product waiting to be packaged.

High maintenance costs—How much time should be set aside for maintenance? The usual answer common to industry in general is: As little as possible to keep machines running efficiently. The packaging industry also has the problem of a further limitation: How much time is actually available for maintenance? This is particularly pertinent to frozen food processors. At the peak of a packaging season, machinery may be working around the clock, seven days a week, keeping up with the tremendous flow of fresh produce. During the brief break between shifts the machine or the processing area must be washed down, and any necessary maintenance performed. There is little time left for even hit-or-miss hand lubrication. The same applies to meat, dairy, candy and other food processors, where washdown is a sanitary requirement and time at a minimum. Washdown demands immediate relubrication, to protect the machine against rust and to replace any lubricant that may have washed away.

Personnel and safety problems—The best type of personnel for operation of packaging machinery may not be very mechanically-minded. Women operators, selected for their dexterity and attention to detail on a packaging line, cannot be expected to understand maintenance of their machines as would, for example, some turret lathe operators. Neither can the woman operator be expected to understand the mechanical complexities or individual characteristics of her machine. So even crude, old-fashioned oil can lubrication of a few critical bearings is difficult to obtain on most packaging operations. The sound or feel of an overheated or rough-running bearing will generally be ignored until one of the maintenance crew happens to notice it—or more usually, until it "freezes up" completely.

Safety measures in effect at most modern packaging plants prohibit oiling of machinery while in operation. Serious injuries often result when this regulation is ignored (The Model Safety Code issued by the International Labor Office takes careful note of this hazard in a number of its suggested regulations—and refers to the advantages of centralized lubrication). Such beneficial safety practices do materially reduce employee injuries, but they also necessitate complete shutdown and lost production time for hand lubrication. Even with the machine stopped, however, it is almost impossible for the oiler to find and to lubricate every single point in the time usually available.

Special handling problems—Many packaged products contain abrasive or corrosive substances that present special problems to the machines packaging them. Tea dust, sugar, corn starch and cleansing powder are all highly abrasive. Packaging machinery handling such materials is subject to special maintenance problems and requires special lubrication attention to remain in top condition. Food-packaging machines must be safeguarded against the danger of fruit or vegetable acids spilling into the machine bearings and causing corrosion. Bearings of bottle filling and labeling machinery may be drenched with the contents of a bottle that breaks as it moves through the line. Many of these bottled products—alcoholic beverages, detergents, bleaches, vinegars, toiletries and others—can very effectively flush lubricant from bearing surfaces. Continuous high speed production on these machines does not permit time

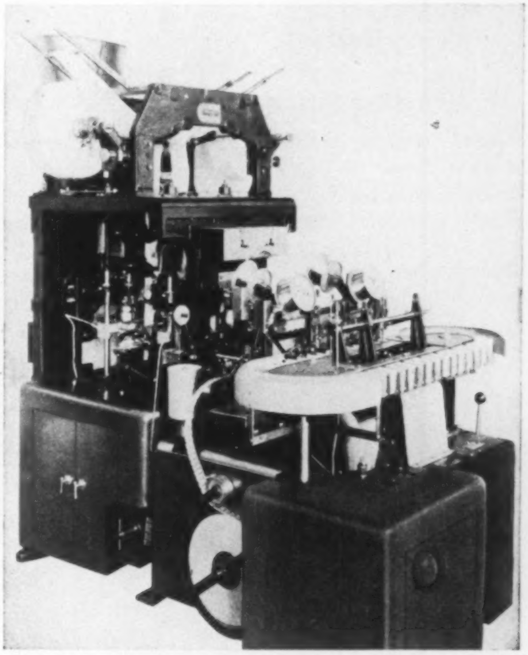

Fig. 3—Combination bagger-tagger-stacker, which produces 160-180 bags of tea a minute, requires constant lubrication to combat abrasive tea dust. It has an automatic lubricating system which sounds an alarm if the oil level drops below a preset point. Elimination of overlubrication is necessary to avoid contamination of the product.

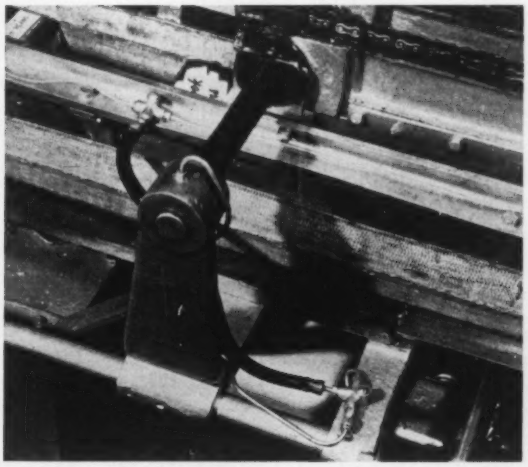

Fig. 2—Cam and spring operated piston in the lubricator distributes oil through a single line system to all necessary lubrication points. Flexible hoses carry oil to moving elements. A metering device filters and measures the oil applied at each point.

out for shutdown and relubrication by hand every time a bottle breaks.

Automated Systems

Each of these problems has been solved on numerous types of packaging machinery by automatic lubrication systems. Bijur Lubricating Corp. supplies systems that are fitted to each machine and are individual in design, depending on the machine and the nature of the lubricating problem. But the general pattern of each of their systems is the same, and has been developed through years of lubrication experience.

The heart of the system is a lubricator pump, mounted integrally in its own reservoir. In most cases the pump is directly powered by the machine that it lubricates, *Fig.* 1. Most packaging machines require a cyclic, automatic lubricator that periodically feeds controlled amounts of oil from the reservoir into the distribution system. With such lubricators the discharge cycle and oil volume may be selected according to the specific needs of the machine.

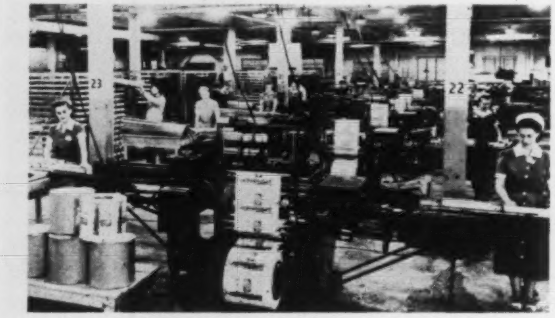

Fig. 4—In peak seasons at this frozen food plant these machines wrap 125-175 packages per minute, 22 hours a day. Washdown for sanitary requirements absorbs time available between shifts and tends to flush lubricant from bearing surfaces. Automatic lubricators protect 75-100 bearings on each machine.

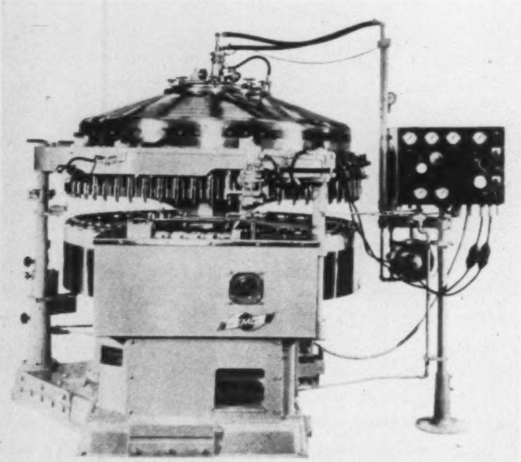

Fig. 5—Over 400 beer cans are filled per minute on this automatic machine serviced by a single lubricator which simultaneously supplies continuous, cyclic or jetting lubrication to individual points on the machine. A float switch automatically stops the machine if the operator ignores a low level warning and the oil level becomes critical. Machine cannot be restarted until oil supply is replenished.

Oil is pumped from the reservoir to the lubrication points through a single-line distribution system, *Fig.* 2, with branch lines and junctions conveying oil to each bearing. Oil lines are usually 3/32 or 5/32-inch brass or copper tubing with flexible hoses to carry oil to moving elements of the machine. At each bearing a metering device filters and measures the oil according to the needs of the specific bearing. This insures that each bearing is allotted its exact oil requirement. The metering device is also fitted with a check valve, which insures a one-way oil flow and prevents drainback, keeping the distribution system full of oil at all times.

In this brief description, only the concept of "unit" lubrication is covered—that is, lubrication systems designed as self-contained, completely built-in elements for each machine. Occasionally, "mass" lubrication has been attempted—feeding oil from one central pump to 5, 10 or even 50 machine distributing systems. However, from all standpoints—practical, economic and engineering—the "unit" lubrication method is far superior: It is rather like comparing today's unit motor drives on machines to old-fashioned lineshafting.

Details of some specific applications of automatic lubrication to high-speed machines are noted in TABLE 1. On the tea bagging machine shown in *Fig.* 3, if the oil level in the lubricator falls below a critical level a special float switch on the lubricator reservoir sounds an alarm notifying the machine operator that the reservoir must be filled. On the battery of wrapping machines shown in *Fig.* 4 lubrication time has been cut by automatic lubricating to a weekly checking and filling of the lubricator reservoirs. The high-speed can filling machine in *Fig.* 5 is fitted with an automatic lubricating system in which a float switch attached to the lubricator reservoir flashes a warning light when the oil level reaches a critical stage. The machine is automatically shut down when the oil reaches a minimum safe level and cannot be restarted until the oil supply has been replenished.

These are but a very few of the many examples of problems solved by automatic lubrication in the packaging industry. Protection of product and packaging material, reduction of machine maintenance hours, prevention of costly production stoppages, less injury hazard to personnel, and safeguarding of expensive machines against abrasion and washing action are some of the major advantages available through modern automatic lubrication. Systems properly engineered to suit the specific needs of a machine and installed during assembly are not expensive—the extra cost is often more than paid back by savings effected during the first year of operation. Men considering automatic equipment in any industry should give careful thought to automatic lubricating systems.

SWITCHING FUNCTIONS

By **JAMES R. WALKER**
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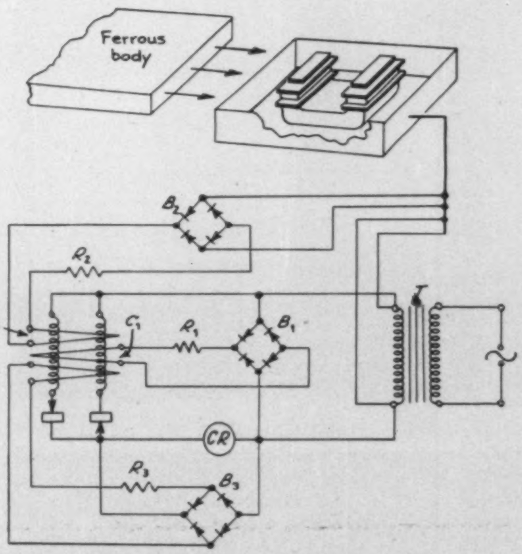
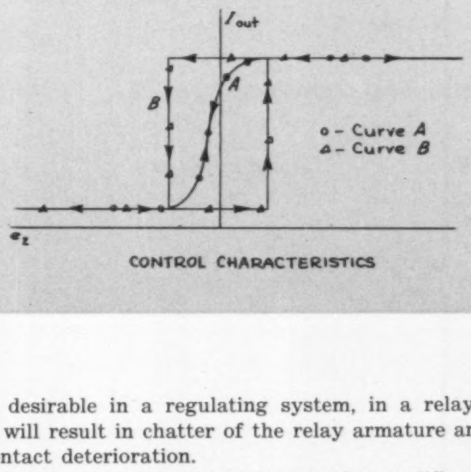
Detroit, Mich.

CERTAIN industrial processes require the use of relay and limit switch devices under operating conditions which may impose an abnormally high mechanical stress on the moving members necessary for their functioning. Because of the limited life exhibited by such stressed members it is desirable to replace as many of them as possible with switching elements containing no movable parts. These application notes, the third in a series of six such articles devoted to magnetic amplifiers, describe the use of magnetic amplifiers in switching circuits.



PROXIMITY LIMIT SWITCH



CONTROL CHARACTERISTICS

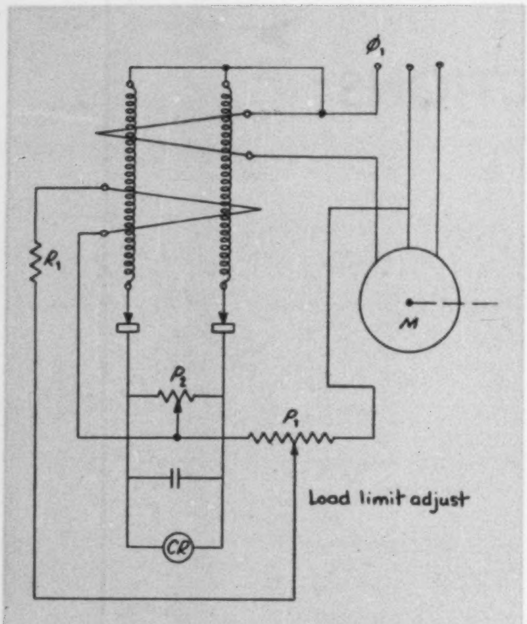
Proximity Limit Switch

A limit switch utilizing magnetic amplifier principles has been designed which is actuated merely by the proximity of a ferrous body. For example, the state of conduction exhibited by the switch changes when the leading edge of a ferrous body approaches within an eighth of an inch of the magnetic pole faces contained within its structure.

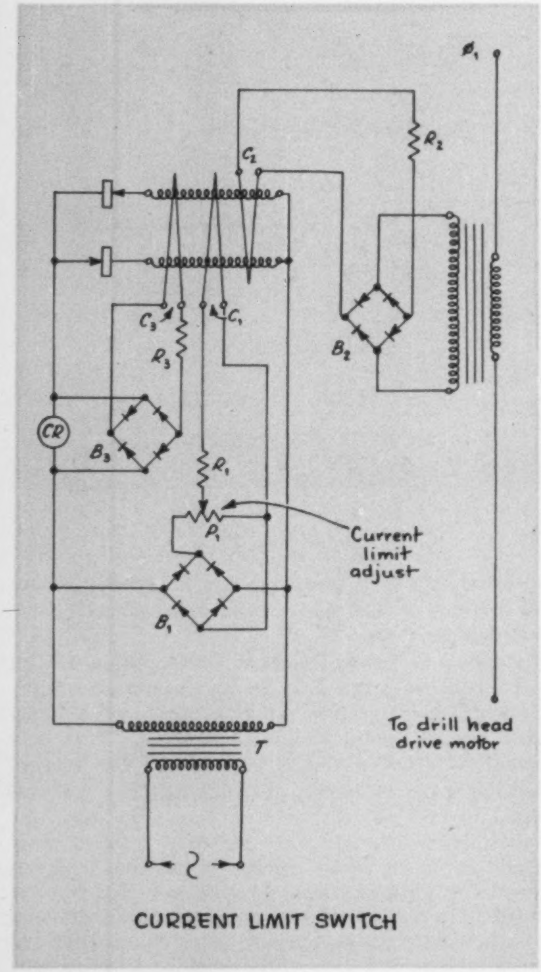
The proximity magnetic pickoff and magnetic amplifier relay circuit which comprise the proximity limit switch are illustrated. The magnetic amplifier is a doubler connected self-saturated type providing ac exciting current for an ac relay which ultimately positions the switching contacts used externally in a control circuit. Switching circuit action proceeds from the initial assumption that the bias rectifier B_1 in combination with resistance R_1 provides suppression bias to reduce the exciting current in relay *CR* far below its dropout value. If now a ferrous body is brought near the pickoff pole faces, the potential of the secondary coil will rise, thus causing an appreciable control current to exist in control coil C_2 and resistance R_2 by virtue of the potential from bridge rectifier B_2.

The relative polarity of bias and pickoff signal ampere turns are such that the latter erases the former and as a result causes the amplifier output current to rise sufficiently to fully excite the control relay *CR*. This action is normally proportional since an increase in the control current of circuit C_2 is followed by a corresponding rise in the output current of the amplifier. Although this is desirable in a regulating system, in a relay circuit it will result in chatter of the relay armature and rapid contact deterioration.

To obtain a switching action in the amplifier, a third control circuit is utilized to provide positive feedback of a sufficient magnitude to render the control characteristic switchlike or bistable in nature. This may be visualized from a comparison of the two control characteristic curves shown in the illustration. A proportional control characteristic is shown as *A* in this figure while the bistable state switching control characteristic is shown as *B*. Although curve *B* is shown as possessing an appreciable hysteresis region it must be noted that the actual means of utilization provides just sufficient feedback current from B_3 so that the potential difference between the rising and falling por-



WATTMETER SWITCH



CURRENT LIMIT SWITCH

tions of the curve is approximately zero. It is not necessary to reverse the polarity of the pickoff potential e_2 to cause de-energization of *CR* since the control characteristic of the amplifier follows the path *B*. A circuit of this type provides excitation for a 3 va relay which may in turn be used to switch larger relays or other circuits.

Wattmeter Switch

An action identical with that of the current limit switch may be provided with this circuit for the same purpose of load limit control of machine members. However, in this case the excitation of relay *CR* is proportional to the active power required by one phase of driving motor *M*.

The magnetic amplifier utilized for this purpose is a half wave type which operates on ac control ampere turns so that its output voltage developed across P_2 is proportional to the magnitude of the supply voltage, the magnitude of the phase current, and the cosine of the angle between these two quantities.

The circuit functions in the following manner: A preset value of bias ampere turns from P_1 will result in saturation of the amplifier cores of a sufficient magnitude to energize relay *CR*. If the closed contacts of this relay are caused to operate a load feed device in order to increase the load on motor *M*, then the rise in phase current of the motor and resulting increase in power factor, will tend to erase the bias ampere turns and cause de-energization of relay *CR*.

An advantage in use of the Wattmeter switch is gained over that of the current limit switch in both sensitivity and elimination of line noise conditions resulting from other machines changing load condition on the same line. Under normal conditions of line voltage variation the smallest signal it is feasible to consider for relay action is 5 watts change in the load condition of motor *M*.

Current Limit Switch

Machine operations involving the use of milling cutters, drills, polishing wheels, and torque adjusters require an indication of the load condition at all times in order that the referenced operating members may be positioned to maintain a constant load. In some cases information concerning the load condition can be obtained from the magnitude of motor phase current existing in a drive motor for the subject member.

An appropriate current transformer may be used for this purpose and its output potential amplified by means of a magnetic amplifier. A study of the illustrated circuit will indicate the similarity to the circuit for the proximity limit switch; however, instead of excitation being provided from a pickoff transformer to bridge rectifier B_2 it is now provided by the sampling current transformer. Further the bias excitation for the amplifier is now provided by potentiometer P_1.

Circuit action occurs according to the relative magnitude of the signal and bias ampere turns in control coils C_1 and C_2. If for example the bias control P_1 is set so the bias ampere turns are greater than the signal then relay *CR* will be energized. If this relay is arranged to feed the subject member into the work, then the resulting increase in load will cause a rise in the current transformer potential and signal ampere turns of control coil C_2. Since the ampere turns in C_2 and C_1 are opposing, the effect of C_2 will be to de-energize relay *CR* and thus limit a further increase in the load condition. Here it must be noted that the polarities of ampere turns due to coils C_2 and C_1 have been reversed compared to the proximity limit switch circuit and that the polarity of C_3 remains the same so that it agrees with the self-ampere turns polarity of the rectifiers included in each load path. Consequently, the bistable action of the amplifier still prevails.

Memory Circuit

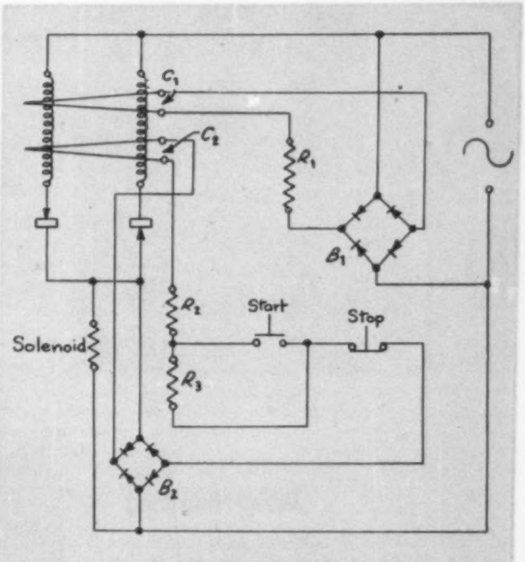
Certain control systems such as those for punch presses require the use of relays to switch associated air control solenoids at rates up to 40 per minute. Although solenoids utilized in these presses have an acceptable life period the control relays do not. It is therefore necessary to utilize static relays of the type employed for energization of control relays as in current limit switch and Wattmeter switch circuits.

A static relay of this type is illustrated. Switch action occurs in this circuit upon the preliminary assumption that the magnetic amplifiers, of the double type, are biased into an essentially nonconductive region by means of current derived from bridge B_1 placed across the ac supply source.

A second and auxiliary control circuit C_2 supplies ampere turns to the amplifier cores which agree in polarity with the self-saturating ampere turns of the amplifier. As a consequence the ampere turns of C_2 provide a positive feedback which render the amplifier nonproportional or switch-like in its control characteristic.

If the amplifier cores have no previous signal history by virtue of the *Start* switch having been closed, then the positive feedback current existing in C_2 is not sufficiently great to switch the cores to their top conduction state.

However, if the *Start* switch is now closed to eliminate R_3 from circuit C_2, then the feedback ampere turns will rise very sharply in this coil, thus switching the amplifier load current to its top conduction state. Since the control characteristic for this amplifier has appreciable hysteresis control ampere turns it is then apparent that the added control ampere turns may be withdrawn by allowing the *Start* button to rise, without causing a change in the state of the amplifier. In fact the amplifier will continue in the top state of conduction until the *Stop* switch is opened, at which time the positive feedback ampere turns are completely withdrawn and the amplifier returns to its low conduction state. Return of the *Stop* switch to its normal position will not cause switching back to the top conduction state because of the large hysteresis.



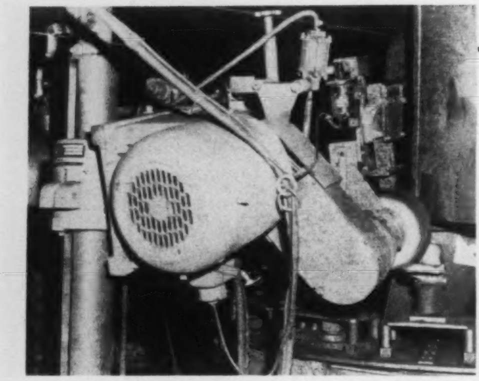
MEMORY CIRCUIT

Amplifiers capable of switching up to 300 va loads are practical; however, it must be borne in mind that the time response of a given amplifier varies inversely with the volume of magnetic material necessary for the amplifier core. As a result the time response of a 25 va amplifier is roughly 1/10 of that for a 250 va amplifier because 1/10 of the amount of iron is required for the same supply voltage. Here the load reactance for the smaller reactor is obtained by use of a copper to iron ratio greater than would be possible with a larger core.

THE AUTHOR

JAMES R. WALKER has been director of research for Gemco Electric Co. for approximately one year. Prior to assuming his present position, he acted as a consultant to the firm for nine years, while as a staff member, and later director, of Wayne Engineering & Research Institute. His academic background includes a Bachelor of Science degree in Electrical Engineering, and a Master of Science in Physics, augmented by teaching experience as a teaching fellow at University of Michigan and as an instructor in electrical engineering at Wayne University, Detroit.

In addition, Walker was, for five years, a development engineer at Ex-Cell-O Corp. where he was responsible for the application of electronic control circuits to machine tools including thread grinders, broaching machines, lathes, and boring machines. His present position involves the direction of research and development at Gemco on electrical and electronic equipment for industrial applications. He is the author of several technical reports and articles dealing with magnetic amplifiers.



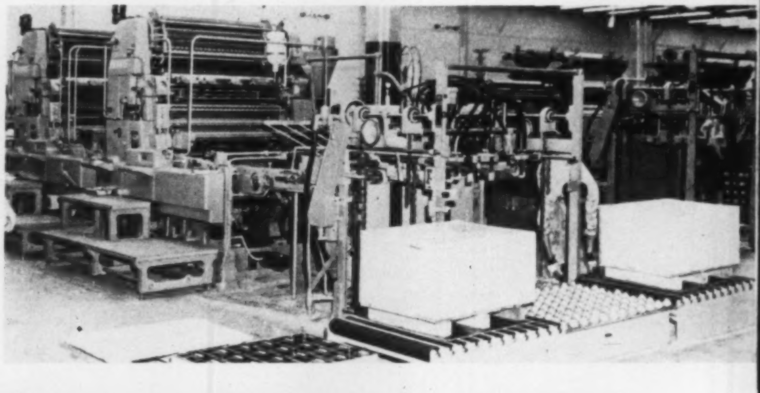
—automation

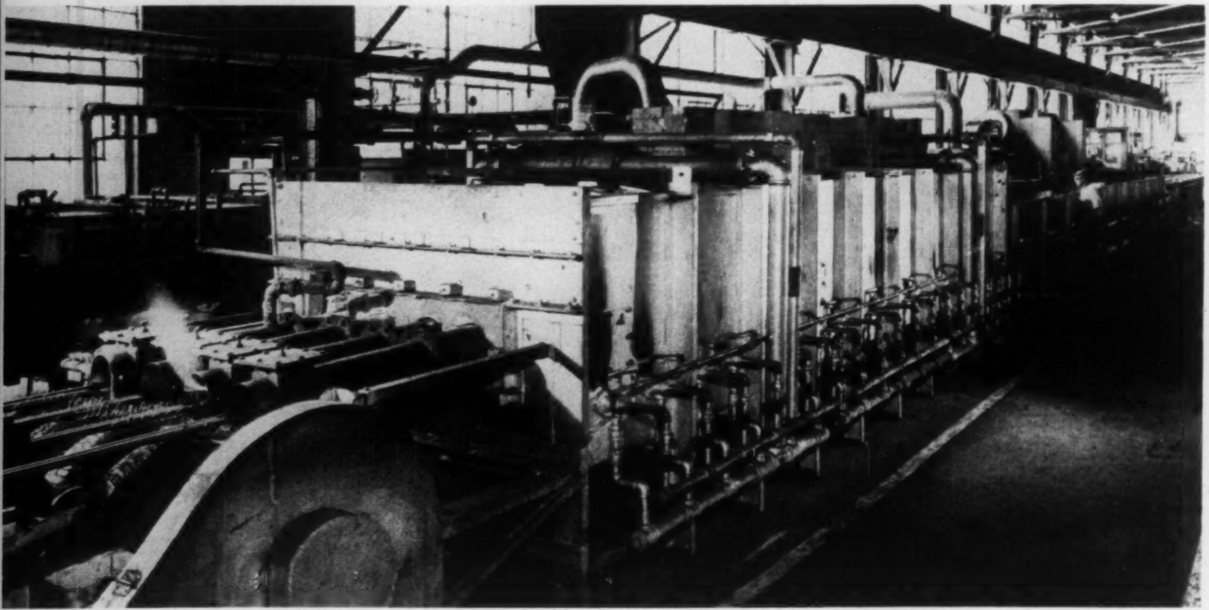
Production Buffing

COMPLICATED castings are buffed automatically at the portable electric tool plant of Black & Decker Mfg. Co. by use of specially designed machinery. In the illustration, an electric saw housing mounted on a turntable is passed under a series of buffing wheels supplied by Hanson-Van Winkle-Munning Co. Casting is repositioned several times during the buffing process so that wheels, set at different angles and positions, can hit the various surfaces of the part. A spring-balanced spindle holds the buffing wheel, permitting it to ride the casting beneath it. A ratchet mechanism, shown above the buff, automatically feeds buffing composition to the wheel.

Pallet Handling

TIN PLATE handling is facilitated at a Crown Cork & Seal Co. lithography plant with the aid of several simple devices. Continuous operation depends upon keeping the high speed Dexter Folder Co. feeders ahead of the color presses supplied with plate. Standby bundles are kept in readiness on two conveyor sections which flank a ball-transfer loading station directly behind the feeder. The Dexter feeder may be loaded before the bundle being fed has been depleted. A sheet of metal beneath each skid provides the requisite surface on which the skids are moved manually as needed.

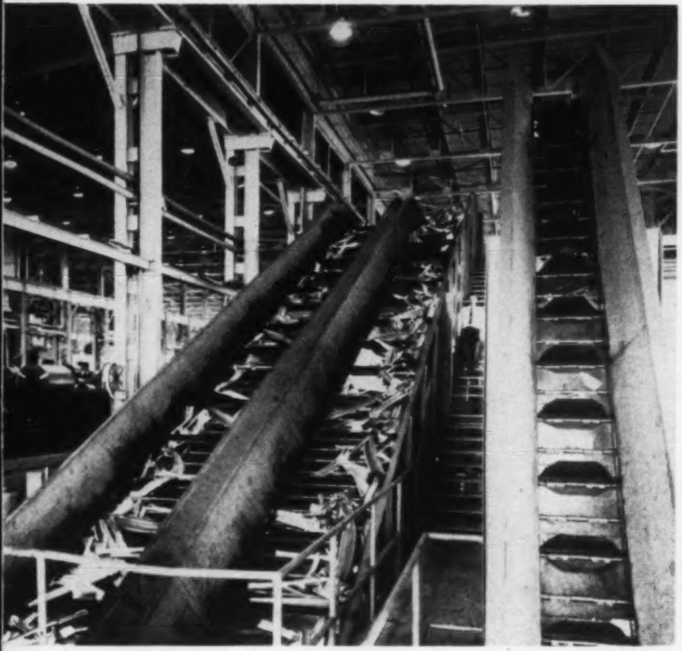




Annealing Furnace

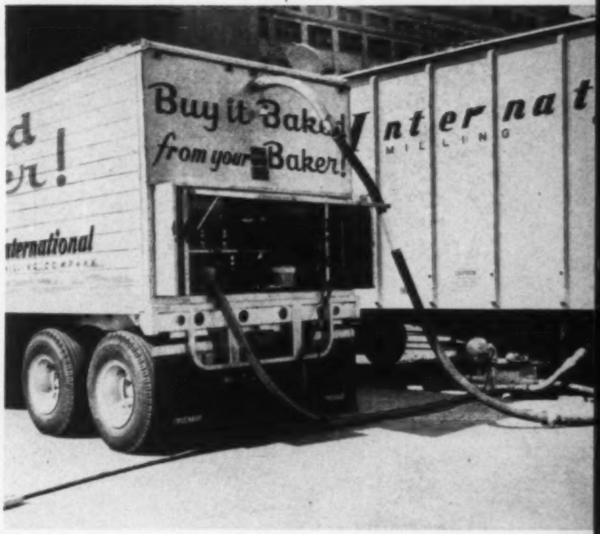
CONTINUOUS bright annealing furnace capable of handling welded stainless steel tubing from ¼ to 4-inch OD has been installed at the Steel & Tubes Div., Republic Steel Corp. Tube processed in the furnace retains the surface qualities of the original flat rolled steel finish without subsequent need for polishing for many applications. This need for polishing is normally an extra cost borne by the tube purchaser, and is an expensive item for food industry users of stainless steel tubing. The furnace has a rated capacity of 1000 lb per hour at a maximum temperature of 2100F. The furnace proper consists of four high temperature alloy steel muffle tubes extending through a gas fired furnace and connecting with tubular, water cooled chambers. Alloy wire mesh chain belts, extending through the furnace, carry the work through the 78-ft long operation at speeds adjustable from 1 to 6 fpm.

in action



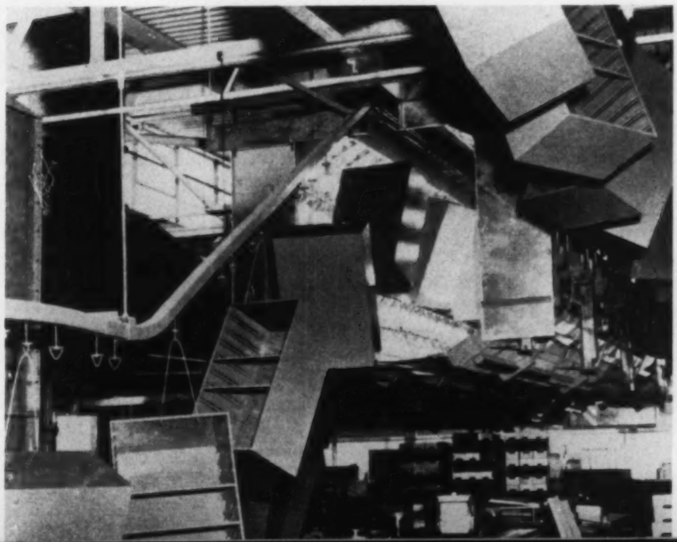
Scrap Collection

DISPOSAL of more than 4500 tons of steel scrap per month is simplified in Chevrolet's Stamping & Frame plant near Flint, Mich. by use of an extensive underfloor conveyor network. Totaling more than a mile in length, three conveyors carry scrap to a central point where large pieces are automatically baled while smaller scrap is loaded into gondola cars. The illustration shows three conveyors leaving the underground run and rising toward the control point. The scrap, destined to be melted down at Chevrolet's Grey Iron Foundry, or sold to scrap buyers, fills some 80 railroad cars with bales and ten with smaller clippings each month.



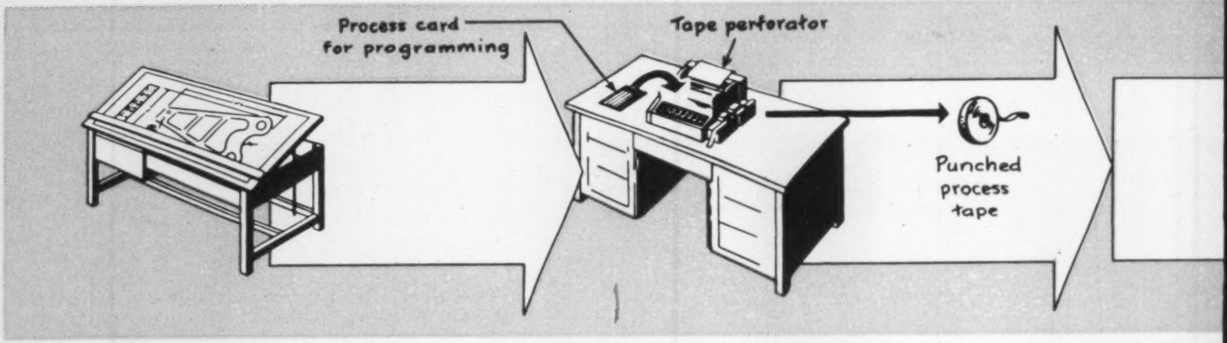
Pneumatic Transfer

COMMERCIAL bakeries remote from milling and distributing centers and without their own rail sidings can enjoy the savings and other advantages of bulk flour delivery by utilizing a portable transfer unit built by the Fuller Co. The unit pneumatically transfers flour or other bulk ladings from General American Airslide railroad cars to Airslide bulk vans or to storage bins and silos. In this system flour is fluidized by air passing up through porous membranes in both the car and transfer unit and flows by gravity into the blow-through feeder. The blowers mounted on the van provide the air to move the material when transfer to a van is being made.



Suspended Ovens

SAVINGS in floor space and uncluttered aisles are immediate benefits achieved by suspending ovens from the ceiling. Wright Line Inc., makes a full line of metal office equipment for the handling, filing and transporting of punched tabulating cards. In a recent plant expansion, the company installed radiant heating equipment manufactured by the Fostoria Pressed Steel Corp. and an integrated finishing, assembling and shipping operation. After the application of a "fine wrinkle" finish, the parts are conveyed to the overhead oven where they revolve slowly on hooks suspended from a monorail conveyor. Parts pass through the 28-ft long oven in 21½ minutes, emerging completely dry, ready for assembling and packaging, and without having interfered with any other plant movement.



PREPARING FOR NUMERICAL CONTROL

IN PARTS MACHINING

Application of programmed controls to production machines is a topic of high current interest. Many programming ideas have been sketched and discussed without reduction to practice. In this article the author discusses considerations in connection with a system which is in final stages of development.

By ROBERT E. REITER
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The Glenn L. Martin Co., Baltimore, Md.

EVEN AT TODAY'S peace-time production rate the machining facilities at the Glenn L. Martin Co. are working at capacity; while machining on future airframe designs is expected to increase many-fold. Looking ahead also to a possible mobilization situation, it is quite apparent that Martin's milling potential will have to be increased. A basic consideration is the trend toward the greater use of forgings, castings, extrusions, and machined fittings in airframes. Two subsidiary factors that must be accounted for are the need for providing means to quickly adapt hastily-recruited, untrained help for high volume production operations and a flexible means of dispersing machining work through subcontracting. Martin is turning to numerical control which provides interesting answers to these problems. With such control the skills required on the production floor are simple loading and unloading and push-button machine operation. Accuracy is assured since it is built into the controlling tape by qualified engineers who direct the preparation of the tape. Milling machines can be set up and operated in remote locations and the parts produced will fit into standardized structures since dimensional control will be an inherent function of an easily reproduced tape.

Aside from the mobilization advantages of numerical control, there are economic advantages which make it worthy of adoption for airframe production. Accuracy and efficiency in the operation of the milling machine become the responsibility of numerical process engineers, and are insured regardless of skill of the operator. Lead time on complex parts is reduced by eliminating cams, templates, etc. which are normally required for control in conventional systems. Martin's goal in the development of numerically-controlled milling pro-

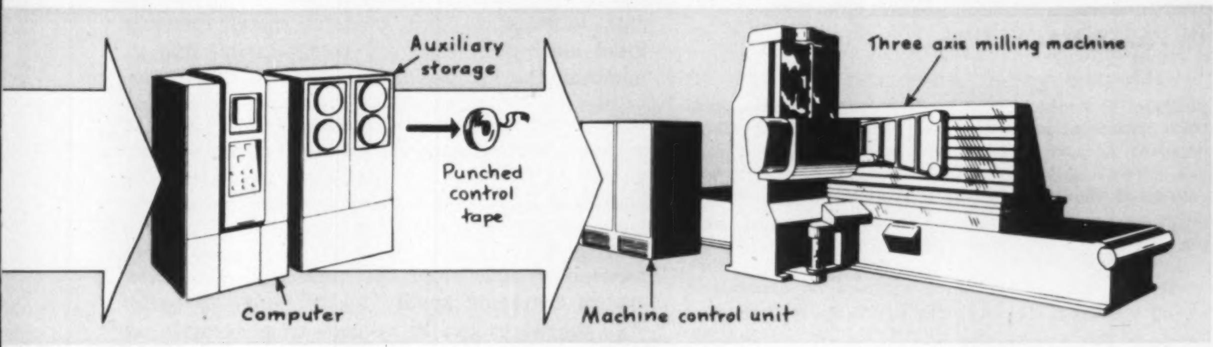
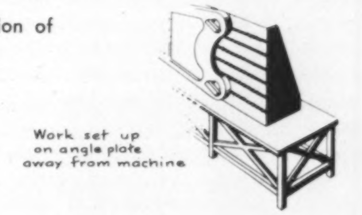


Fig. 1—Schematic representation portrays important steps in production of airframe components by means of tape controlled milling machine.



cesses for the future is to eliminate even the part drawing, substituting the design engineer's formulas and coding them directly on a tape.

Martin expects to be the first to apply numerically-controlled three-dimensional milling to aircraft production when they receive their system, now on order, early this year. This pioneering has raised questions about procedures and policies that are new to the aircraft industry. Consequently, Martin has undertaken a comprehensive program of studying the new situations that will be created when the numerically-controlled system goes into operation. People are being trained and new procedures are being developed to insure that soon after installation of the equipment, milling of production parts can begin.

With the purchase of a new numerically-controlled milling system, Martin is in the unique position of being able to fill a vital gap in the USAF Plan for Production Automation. Because of its ability to perform programming functions automatically for three-dimensional milling, this system when installed will be the most complete of the numerically controlled systems scheduled for installation. It will, therefore, enable Martin to test the capabilities of numerical control in the widest possible array of machining situations.

▶ Choosing the System

There are several systems under development for automatically controlling machines. It is difficult to choose one that is superior; but Martin's choice centered on two questions: flexibility and use of magnetic or punched tape. A punched tape system was chosen because the initial cost of the equipment was less, and the equipment was simpler and easier to maintain. Operating costs are considerably less because the tape itself is cheaper and less is used in comparable normal operations. A punched tape is easily reproduced, can be shipped to subcontractors, and can be stored indefinitely without loss of fidelity.

The lead time needed to produce the control tape is a governing factor in selecting a system. To be competitive in this respect the computing element in the system should perform all the calculations such as automatic tool offset etc. with a minimum amount of assistance from the programmers. The system selected provides this flexibility.

The Martin system, *Fig.* 1, is being designed and built by Bendix Aviation Corp. It will include a tape perforator on which a process tape will be prepared. This will be fed into a computer which will convert process data into control data punched on a control tape. Numerical data for analytic functions and other routine movements will be preprogrammed and stored in the memory unit. When such movements occur in the program for a specific part, the computer automatically draws data from storage, and records the data on the control tape. A machine control unit will convert the data from the tape into movements of a machine, such as a Kearney & Trecker horizontal type milling machine.

▶ Preparing for System Use

Since there are five major functions involved in the transition to automatically controlled production, the development of procedures and orientation of personnel are proceeding along these fronts:

1. Standardizing design criteria and design elements for parts to be produced by the numerically-controlled milling system.

2. Defining mathematically the part to be produced. Key points on the part are located as co-ordinates in relation to a point of origin. Lines between these points are defined analytically.

3. Numerical processing. Movements of the cutter are programmed in correct sequence to cut metal along the lines defining the parts to be produced. The

program is coded on a tape and fed to the machine; from this point manual operations are virtually eliminated.

4. Operating the machine. Machine operation will consist of elementary operations of starting and stopping; loading and unloading. Standardization of these operations will permit use of unskilled labor.

5. Machine maintenance. It will be imperative that numerically-controlled milling systems be maintained at top operating efficiency for maximum utilization.

Development of universal procedures and instructions for each of these five operations will include a preliminary study of the problems and indoctrination of personnel in co-operation with the manufacturers of the milling machine system before it is installed.

A representative number of actual production parts have been selected for initial production by the system. The parts were selected with a view to subjecting the system to the widest possible range of circumstances encountered in airframe production. Study of approximately 25 typical airframe fittings is underway, ranging from the smallest to the largest and most complex that can be accommodated on the bed of the milling machine. These fittings are being analyzed to establish standard design elements which will be compatible with efficient operation of numerically-controlled systems. Basic forging or casting designs are being studied and standardized to eliminate unnecessary and wasteful metal removal. Fillet and corner radii are being standardized to minimize the number of times the machine must be stopped for cutter changes. Design drawings of parts to be milled by the numerically-controlled system are being standardized to give programmers and tool designers a consistent picture of the parts and an orderly beginning for processing, programing, and coding the data.

Weight-saving advantages of the precise tolerances obtainable from the numerically-controlled system are being applied to the design of parts. Web tolerances can be reduced from as much as 0.045-inch to 0.004-inch with a potential weight-saving of 0.041-inch of material without affecting the specified strength. The next major change from conventional design practice is the mathematical definition of each part. Instead of dimensioning the part in detail, as shown in *Fig.* 2, a point of origin is established and the distances from this point to all the key points defining the part are given as co-ordinates. The lines defining the shape of the part between the key points are expressed as equations which can be solved by the computer unit and recorded in a binary code. A preliminary attempt to define a typical airframe part is shown in *Fig.* 3. Locations of the key points with respect to the reference point are shown.

The cutting head of the machine will move in straight-line increments to points defined by the x and y co-ordinates. Curves (hyperbolic, parabolic, elliptic, etc.) will be defined by formulas

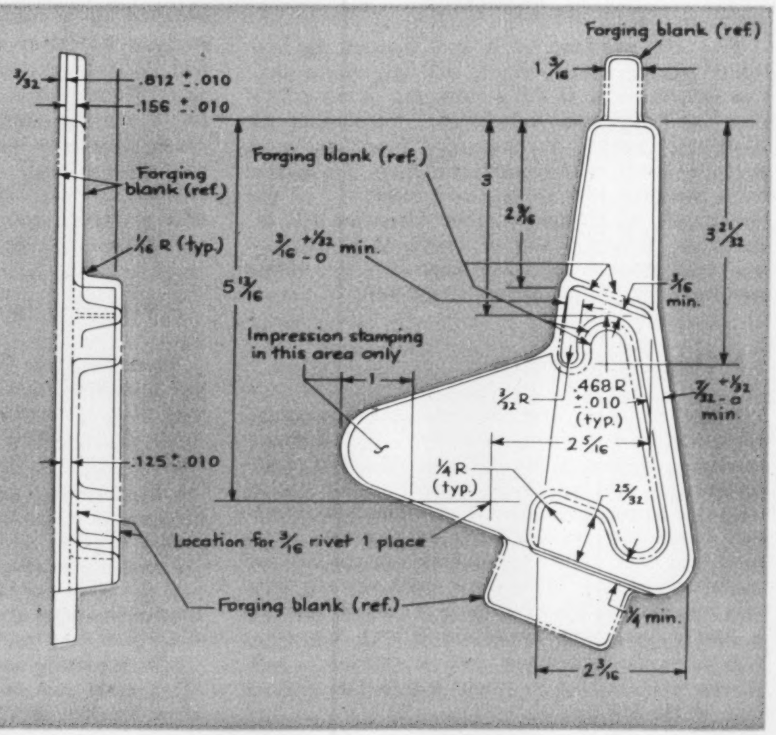


Fig. 2 — Typical drawing for an aircraft fitting to be produced in conventional manner by operator guided machines.

which will locate several points on the curve. The number of points will depend on the tolerances specified. Thus, to cut a curve, the cutter will move in straight-line increments to points around the curve.

Mathematical definition is illustrated in *Fig.* 4. The beginning and end points of all lines are defined as x and y co-ordinates with relation to the point of origin. If the machine begins cutting at Point 1, it will proceed in a straight line to Point 2 and again to Point 3. From Point 3 to Point 4, it will proceed to points along the curve defined by an equation. This is a very simple example; complicated parts may require several linked formulas for definitions of compound curves. Also, equations will have to be calculated for additional analytic functions. Equations defining routines will be available automatically from the stored program information in the memory unit of the system.

▶ Numerical Programming

Numerical programming is an entirely new element in the normal sequence of operations from designing airframes to producing them; it means numerically stating the commands for the milling machine. The numerical process team will consist of a numerical processor, a mathematician, a tool designer, and a key-punch operator. Their function will be to process design data and prepare it for the numerically-controlled milling system. Cuts must follow in an orderly sequence so the part is milled to the design specification; certain precautions must be taken when milling thin web sections; and proper coolant flow and cutter speeds and feeds must be specified. Many of these factors will be anticipated for applications in general, and machine directions standardized and stored in the memory unit.

This is the most important phase of the operation of the system, consequently, the integration program includes the development of methods of training the personnel and standard methods and techniques for performing the various tasks. These tasks will include preparation of standard forms for all programming operations and guides for such operations as plotting points of compound curves which cannot be programmed with the use of the stored program information. These forms and guides will permit operation of the system by personnel with nontechnical skills. Later, when the system is installed, actual machine operation will be analyzed to determine optimum feeds, speeds, loads, depths of cut, surface finishes, and other elements for all commonly used materials. All phases of numerically-controlled system operation will be studied to determine advantages which can be integrated into numerical techniques. For example, symmetrical parts may be produced by processing one-half the machine operations and reversing the tape for the other half.

Information will be compiled and methods of

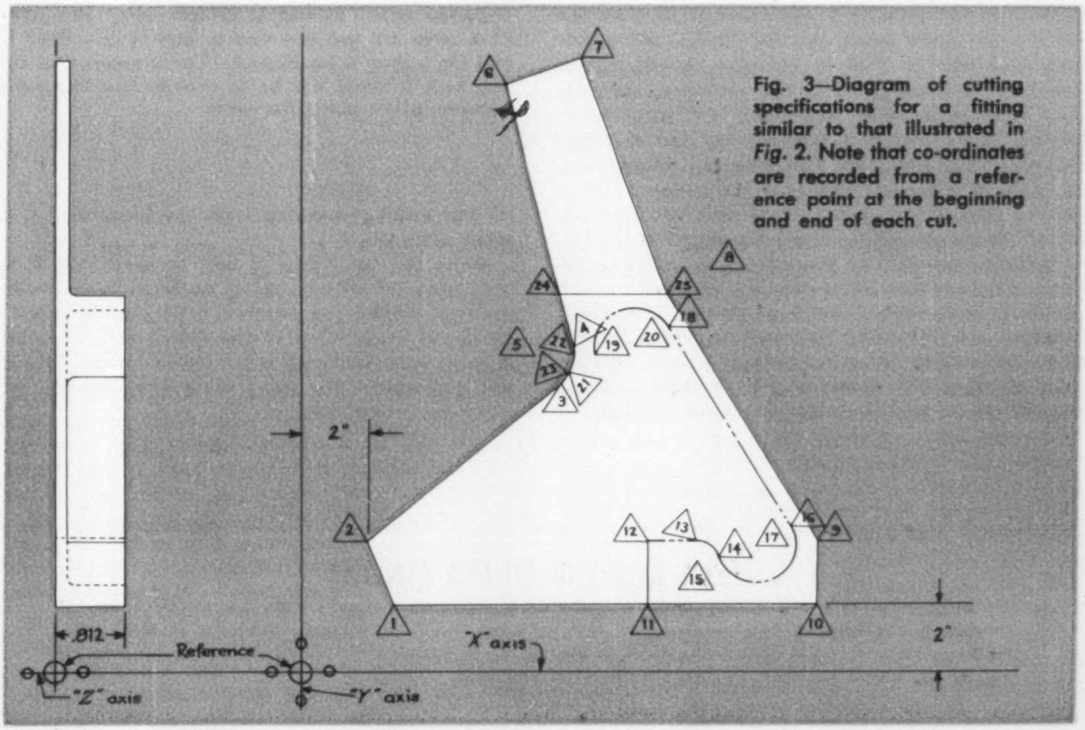


Fig. 3—Diagram of cutting specifications for a fitting similar to that illustrated in *Fig.* 2. Note that co-ordinates are recorded from a reference point at the beginning and end of each cut.

training will be developed for instructing numerical processing personnel. A thorough course in all phases of the operation of numerically-controlled systems is under development with special emphasis on those factors which will affect the numerical processing function, including: Interpreting design drawings with mathematical definitions and co-ordinate dimensioning; translating data for coding, including such functions as plotting points of compound curves or other irregular shapes; arranging sequences of milling machine operations and preparing programs; specifying correct feeds, speeds, depths of cut, surface finishes, etc.; and preparing tapes, including operation of Flex-O-Writer and computer.

System Goals

The foregoing design and numerical processing operations include the major changes in conventional manufacturing practices. They place responsibility and decision-making entirely in the hands of highly skilled engineers. The work of design draftsmen is somewhat simplified; process planning is replaced by numerical processing. Errors are minimized because once information is coded on a tape, human interpretation is not required again.

Eventually, when the procedures are perfected, it will become possible to eliminate detail drawings as we now know them. At that time, a structures engineer will be able to envision the fitting he needs at a given point in the airframe, calculate the stresses it must withstand, and analytically define it by formulas representing the size and shape of the part. He will give the programmer a table of numbers with only the general outline of the part sketched out. This data will be sufficient for programming and producing the part.

Actual operation of the milling machine in the numerically-controlled system is a relatively simple task. It will consist chiefly of making the setups, loading and unloading the machine, changing cutters or making other adjustments, and starting and stopping the operation. It is the essence of numerical control to reduce machine operation to elementary tasks that can be performed by personnel with nontechnical skills. Nevertheless, it is advisable to study the personnel requirements of this job carefully and make specific recommendations as to the qualifications of operating personnel. Job analysis and classification are specific parts of this integration program.

In view of the high capital investment in these systems, it is imperative that they be maintained at top operating efficiency for maximum utilization. Standard procedures for preventive maintenance and emergency repair follow customary maintenance practices in most cases but special attention is given the following points: Data processing functions of the computer or director must operate properly at all times; systematic preventive maintenance of all electronic systems is essential; mechanisms operating along the three axes of the milling machine must perform with constant accuracy.

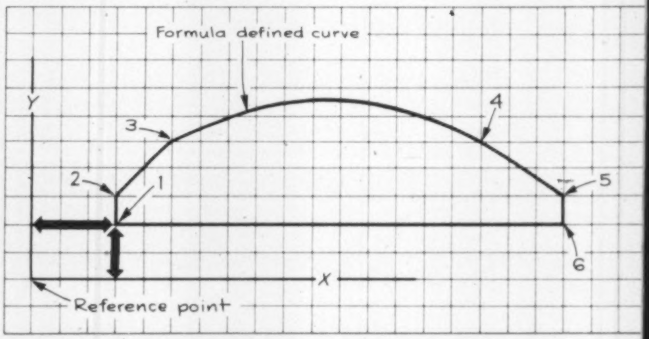


Fig. 4—Sketch illustrates the dimensioning of end points of curved section as well as straight lines. End points of a curve are specified and a formula is defined so that the outline is established. Cutter progress in cutting such a curve will be in straight line increments between points along the curve.

From the foregoing, it will be seen that there are many ramifications to numerically-controlled systems besides the physical development, fabrication, and installation of the systems of machines. A most important step is the development of standard procedures for integrating the systems into airframe production.

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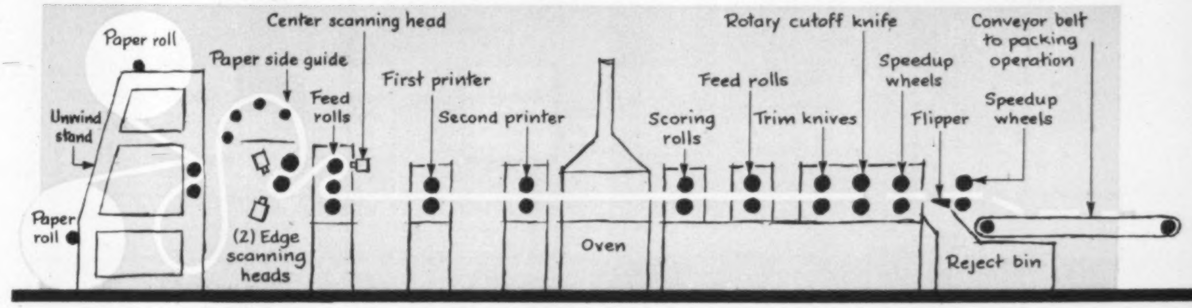
Paper roll
Center scanning head
Paper side guide
Feed rolls
First printer
Second printer
Rotary cutoff knife
Feed rolls
Scoring rolls
Trim knives
Speedup wheels
Flipper
Conveyor belt to packing operation
Speedup wheels
Unwind stand
Paper roll
(2) Edge scanning heads
Oven
Reject bin

Fig. 1—Processing line for printing and cutting sidewalls of paperboard milk containers.

MAGNETIC MEMORY LINKS

CONTINUOUS INSPECTION AND SORTING

Processing line operating at high speed requires memory device between remotely located inspection and sorting stations so that material classed as defective can be diverted from regular flow.

By THOMAS G. SLATTERY and ARTHUR JOYCE

Vice President
Automation Inc.
Wellesley, Mass.

Mechanical Engineer
Oswego Falls Corp.
Fulton, N. Y.

A HIGH SPEED AUTOMATIC inspection and sorting system combining photoelectric inspection, magnetic memory and pneumatic ejection is now in use in a paper converting operation at the Sealking Div. of the Sealright Co. Inc., Fulton, N. Y. The basic inspection and control system is directly applicable to continuous process lines used in the manufacture of sheet metal, paper products, wire, tubing, plastic sheet and textiles. The system is the result of the combined efforts of the mechanical engineering staff at the Sealright Co. and of Automation, Inc., Wellesley Hills, Mass., designers and manufacturers of analog and digital control systems for industry. Development of this system is a good example of the success that can be achieved by the close co-operation of experienced mechanical plant engineers and outside automation specialists. The one factor that contributed most to success was the care and completeness with which the engineering staff of the Sealright Co. described the specific details of the problem to the engineers of Automation, Inc.

The Sealking Div. converts raw paperboard into plastic coated sidewall, top and bottom container blanks. These are then shipped flat-packed to dairies throughout the United States where they are automatically assembled into finished paper cartons, sterilized, filled, and sealed by a Sealking machine in an in-line operation. The paperboard cartons are used for milk products and fruit juices.

Both the nature of the product and the process carried on at the dairy requires that the paper blanks be without holes, completely coated with plastic, free from splices, and be of particularly high quality. Since it is very difficult at the normally high manufacturing speeds to carry out the required 100 per cent inspection by manual methods, an automatic inspection and sorting system was indicated. At the present time, automatic control has been installed on only one sidewall processing

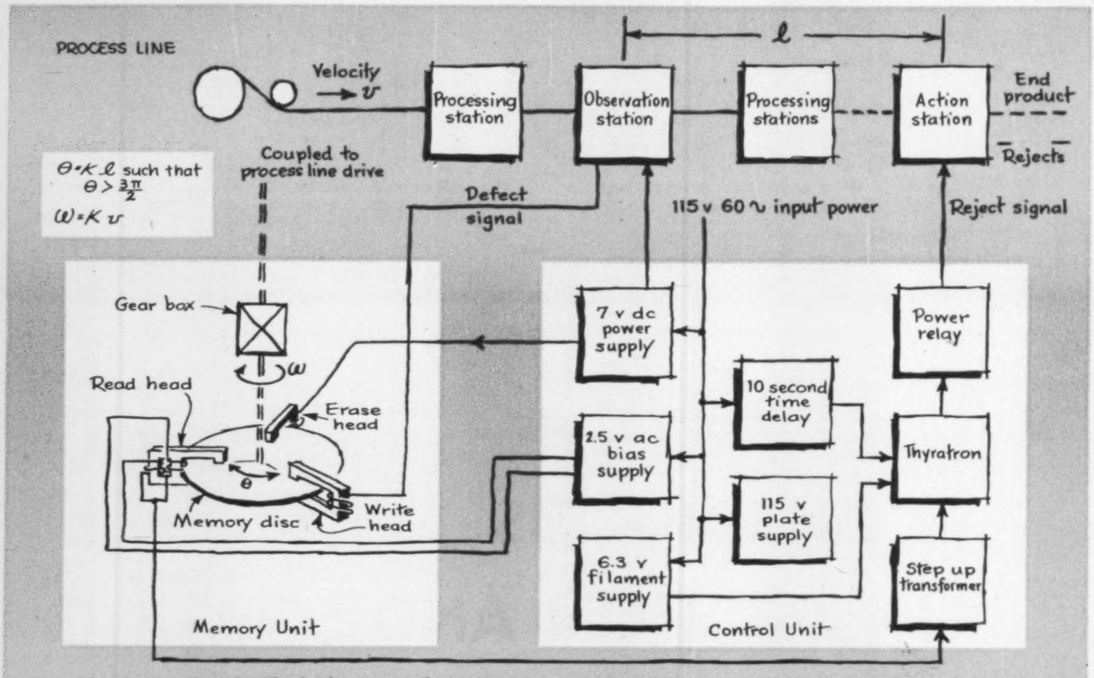
PROCESS LINE
Velocity
→ v
Processing station
Observation station
Processing stations
Action station
End product
Rejects
l
θ=K l such that θ > 3π/2
ω=K v
Coupled to process line drive
Defect signal
115 v 60 ∿ input power
Reject signal
Gear box
ω
Read head
Erase head
θ
Write head
Memory disc
Memory Unit
7 v dc power supply
10 second time delay
2.5 v ac bias supply
115 v plate supply
6.3 v filament supply
Power relay
Thyratron
Step up transformer
Control Unit

Fig. 2—Block diagram of processing control system using magnetic memory.

line. However, similar installations are to be made in the near future, on the remaining sidewall machines plus the top and bottom blank processing lines. The systems installed on the top and bottom blank processing lines will differ from the present installation primarily in the nature of the sorting mechanism used at the delivery end of the line.

The automatic inspection and sorting installation on the sidewall blank processing line consists of three basic systems: (1) The observation system, (2) the Magdelay memory system, developed by Automation Inc., and (3) the sorting system. A brief step by step description of the events involved in inspecting and ejecting defective material will explain the interaction of these three basic systems.

The sidewall blank processing line, *Fig.* 1, receives paperboard in roll form, which has been previously plastic coated. This plastic coated paperboard is successively inspected, printed, dried, scored, slit to the width of the individual carton, cut off to the proper length, sorted into acceptable and rejected material and delivered in a shingled arrangement on a slowly moving delivery belt. Once the initial adjustments have been made, the sidewall machine is normally operated at the steady rate of 600 feet per minute. *Fig.* 2 is a simplified block diagram of the overall control system.

Defective material passing an observation station actuates a photoelectric relay which in turn energizes a *Write* head of the Magdelay magnetic memory system. When this *Write* head is energized, it "writes" a magnetic mark on a hardened steel memory disc whose angular travel is proportional to the travel of the web through the processing line. When this magnetic mark has traveled from the *Write* head to the *Read* head, the defective section of material will have traveled from the observation station to the sorting station. A relay in the control panel of the memory system is then actuated, which in turn energizes the solenoid valve of the sorting system. Energizing this solenoid valve admits pressure to an air cylinder which moves a flipper from normal delivery to eject position. The defective material is then directed to the reject bin.

▶ Observation System

The observation system consists of three photoelectric relays and three associated scanning head assemblies, *Fig.* 3. The function of this system is to sense defective sections of the plastic coated paperboard. *Fig.* 4 is a photograph of the control panel housing the relays of the system.

Sensing faulty material is based upon measuring the amount of light specularly reflected from the surface of the board at a low, grazing angle, *Fig.* 5. Any condition of the paperboard resulting in a decrease of this reflected light is interpreted as indicating defective material. Typical conditions are: (1) Absence of plastic coating; (2)

dirty or smudged surface; (3) presence of masking tape used in making splices; and (4) torn out portions, holes or ragged edges of the paperboard.

Both sides of the moving web are scanned for defects. A path is scanned adjacent to each edge of one surface, and a single path is scanned in the center of the reverse surface. While scanning three paths does not give complete coverage of the board, experience has indicated that it will detect the majority of the defective material present. It would, of course, be desirable to be able to scan the entire face of the web for defects, and equipment which will continuously sweep the face of the web at the rate of 500 cycles per second is now being developed.

The sensitivity requirements of the observation system were dictated by the need to not only discriminate between coated and uncoated board, but to also be able to evaluate the quality of the coating. Differentiating between coated and uncoated board is very difficult for an untrained observer; and evaluating coating is only possible with the aid of various stains. The sensitivity of the obseration system can be illustrated best in terms of a photoelectric relay sensitivity scale reading. Using a percentage scale with 100 per cent indicating a very high grade coated surface and 40 per cent indicating uncoated paperboard, the quality of coating that will be accepted is established by adjusting the relay sensitivity to a predetermined reading between 40 and 100 per cent.

After some experimentation, a commercially available photoelectric relay having the necessary sensitivity, resolution, speed of response, and reliability was selected. The unit has functioned very satisfactorily, requiring only routine tube and lamp replacement after several thousand hours of operation. Component aging does not affect operation, so relay adjustment is necessary only when components are replaced. Defective material which has been in the field of the observation system for times on the order of only two milliseconds has been detected, indicating excellent response time.

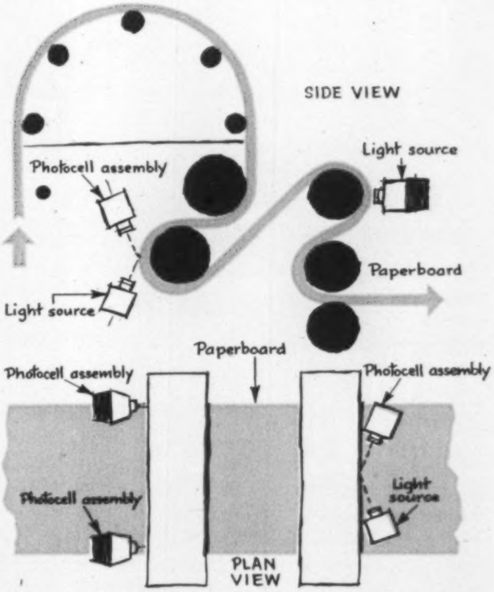

Fig. 3—Mounting arrangement of scanning head assemblies.

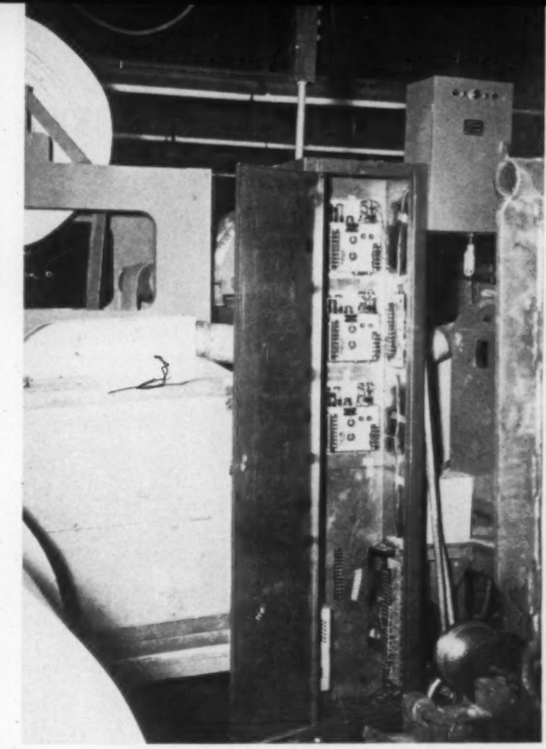

Fig. 4—Memory unit is shown in lower right mounted between parts of the processing equipment; control unit for the memory unit is at upper right. Cabinet, with door open, houses associated relays.

The scanning head assembly consists of a lamp and an associated phototube, each having its own individual housing and optical system. Both assemblies are fastened to a common mounting bracket as shown in *Fig.* 5.

The following requirements had to be met in designing the scanning head:

1. The space relationship between lamp, phototube, and paper surface is very critical and has to be rigidly held once adjusted.

2. To accommodate the different web widths that are used in production, the scanning heads have to be easily adjusted laterally by the machine operator with no loss in critical alignment.

3. The phototube has to be shielded from all light other than that reflected from the scanned path on the web.

4. The lens system should require cleaning only when phototubes are replaced.

The above requirements were complicated by space limitations, vibration in the machine members that were available for mounting, and the ex-

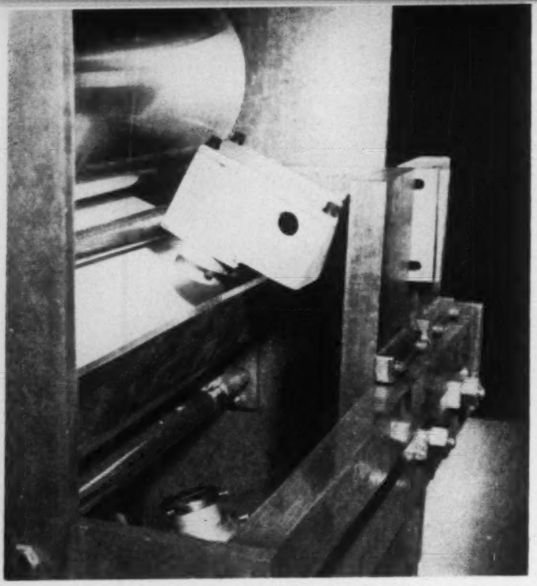

Fig. 5—Scanning head assembly being installed near one edge of web.

treme paper dust conditions in the immediate vicinity of the scanning heads. However, the equipment which was developed fulfills these requirements. Scanning heads now require attention only after several thousand hours of operation.

The two photorelays inspecting the bottom surface of the web are in line across the width of the paperboard perpendicular to the line of flow. The single photorelay inspecting the top surface is separated by approximately 3 feet, along the line of flow, from the two bottom photorelays. The top photorelay closes one circuit when a defect is observed. This closure records a signal in the Magdelay memory unit. Either of the bottom photorelays closes a second circuit, when a defect is observed, again causing a signal to be recorded in the memory unit.

▶ Memory System

The memory system consists of two major items: the memory unit, *Fig.* 6, and the control unit, *Fig.* 7.

Signals generated by the photorelays are used to magnetize narrow sectors of a hardened steel disk by activating magnetic *Write* heads which are shown in *Fig.* 6. There are two *Write* heads, corresponding to the two different positions along the paperboard processing line where the photorelays are installed. *Write* head *A,* is activated by the photorelay inspecting the top of the paperboard and *Write* head *B,* is activated by either of the photorelays inspecting the bottom of the paperboard.

The memory disk rotates with an angular velocity directly proportional to the flow rate of the paperboard along the process line. Synchronization is achieved by coupling the drive shaft of the process line to the input shaft of the unit by a belt and gear system.

Displaced from the *Write* heads around the disk is a single *Read* head. The angular spacing of the *Write* and *Read* heads is adjusted such that the paperboard travels between the observation and the sorting station on the process line in the same period of time that a radial line on the disk rotates through the angle between the *Write* and *Read* heads. Variations in the speed of the process line will not alter this physical relationship.

A defective section of paperboard can, therefore, be observed and recorded in the memory by the *Write* heads. The sector of the disk indicating this defect revolves until it reaches the *Read* head. This head is of the static flux detector type i.e., the head will detect magnetized sectors of the disk no matter how fast or slow the paperboard process line is moving or if the process line is at a dead stop.* Thus, correct sorting signals are obtained independently of speed variations of the paperboard processing line. These sorting signals, as detected by the *Read* head, are transmitted to the control unit of the Magdelay system. After passing the *Read* head, the magnetized sectors of the disk pass under the *Erase* head which demagnetizes charged sections of the disk. That section of the disk is therefore ready for reuse when it again arrives beneath a *Write* head.

Signals generated by the *Read* head are transmitted to the Magdelay system control unit, *Fig.* 7. The control unit uses these signals to activate a

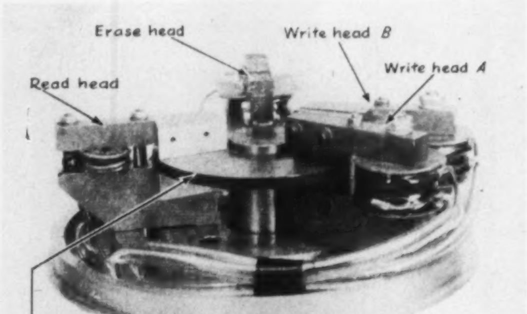

Fig. 6—Magnetic disk memory unit showing principal components.

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*Most magnetic *Read* heads have outputs that are proportional to the speed of the memory medium moving past the head; at zero speed this type of head has no output.

power relay whenever a defective piece of paperboard arrives at the sorting station. This power relay circuit controls the sorting system.

▸ Design Considerations

A high speed "memory" system was obviously required for this process line sorting problem. Mechanical memory systems were too slow and subject to excessive wear. Magnetic memory systems possessed the speed and were not subject to wear since there is no physical contact between the memory disk and the magnetic heads. However, two problems arose when magnetic memory systems were considered for this application.

The first problem was related to the constraint that the process line started and stopped rather frequently. During the time that it started up or slowed down, the correct sorting signals were still to be generated. That meant that signals recorded in the memory, and signals read out of the memory, must not be affected by variations in the speed of the process line all the way from a dead stop to maximum speed. The problem was solved by using a special static flux detector *Read* head.

The second problem was the joint achievement of a minimum quantity of *Read-in* and *Read-out* equipment while still obtaining sufficient memory capacity and resolution. The usual magnetic memories, namely magnetic tape and magnetic drums, have more than sufficient memory capacity and resolution. *Read-in* and *Read-out* equipment however, becomes complex, primarily because there is only a small quantity of magnetizable material that can be used to record the information. The magnetizable material on a magnetic tape is in the order of less than a mil thick and the same can be said of the magnetizable material on the surfaces of magnetic drums. This problem was solved in the Magdelay systems by using a magnetizable disk that is 0.2 inch thick and magnetizing a sector of the disk. This technique resulted in simple *Read-in* and *Read-out* equipment while still yielding more than adequate resolution and capacity for this particular problem as well as for most other industrial applications.

The resolution or this memory system can be defined in terms of the minimum angular sector of the memory disk that is required to record a signal. With the 4-inch diameter memory disk used, 6 degrees of angle are required to write one individual mark. Two marks occupying adjacent 6-degree sectors of the disk will each independently activate the power relay output of the control unit. Thus, each 6-degree sector of the disk can be considered as an individual memory cell. With systems utilizing larger diameter memory disks, higher resolution can be obtained.

The maximum theoretical capacity of the system used is 60 memory cells. However, due to the interaction that occurs when the *Erase* head and one of the *Write* heads are placed side by side, only about 300 degrees of the disk can be used. Thus approximately 50 memory cells is the capacity of the system.

The precision or repeatability can be measured by the uncertainty in position over which the output power relay will throw. If the angular position of the disk at which the relay throws is noted, and the closure is repeated slowly a number of times, it will be found that the closure occurs within ±¼-degree of a fixed position. This, then, is the precision of Magdelay 1000 at zero speed. An error is introduced when the angular speed of the memory disk is increased due to the 60 cycle frequency present on the thyratron in the control unit. The velocity component of this error can be reduced to almost any desired value by increasing the frequency applied to the thyratron.

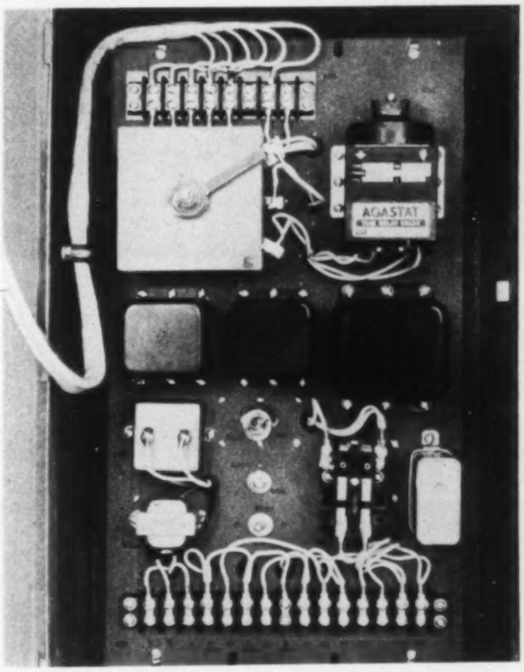


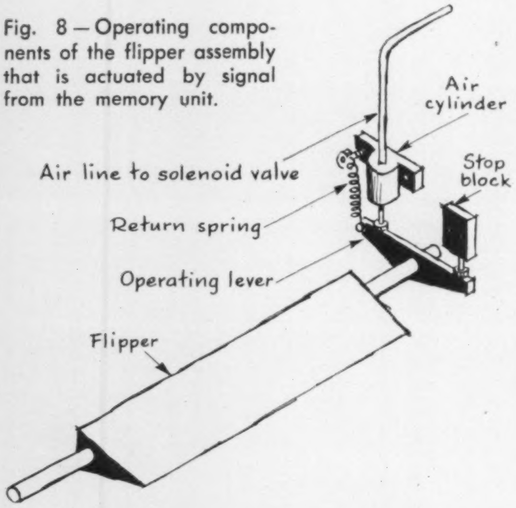
Fig. 7—Control unit for magnetic disk memory unit.

▸ Sorting System

The sorting system consists essentially of a mechanism to divert the defective blanks from the normal process line plus a defective material bin.

The flipper assembly, shown schematically in *Fig.* 8, and in photograph, *Fig.* 9, is a mechanism which diverts the defective blanks from the normal process line into the defective material bin. The flipper is a light sheet metal guide rigidly attached to a shaft. A single acting air cylinder and a re-

Fig. 8—Operating components of the flipper assembly that is actuated by signal from the memory unit.



turn spring acting on a lever, which is keyed to one end of the shaft, actuates the flipper assembly. This mechanism is simple, rugged, and performs satisfactorily.

The defective material bin is a large sheet metal box located directly under the delivery belt which conveys acceptable blanks to the packers. This bin must be large enough to hold the defective material accumulated in several hours of normal operation, and be readily accessible for rapid unloading.

Delivering plastic coated paperboard blanks from the sidewall machines is at best a marginal operation subjected to frequent malfunctions. The leading causes of this difficulty are:

1. Paperboard is subjected to curling and warping.
2. Blanks cannot be rigidly guided since the plastic coating is easily damaged by scuffing.
3. Frictional characteristics of the plastic coated surface vary from time to time.
4. Blanks leaving the speed-up wheels at approximately 1300 feet per minute must be decelerated to the inching speed of the conveyor within a distance of about one foot without damage to the blanks.
5. Mechanisms used must be sufficiently rugged to withstand the forces encountered in jam-ups.

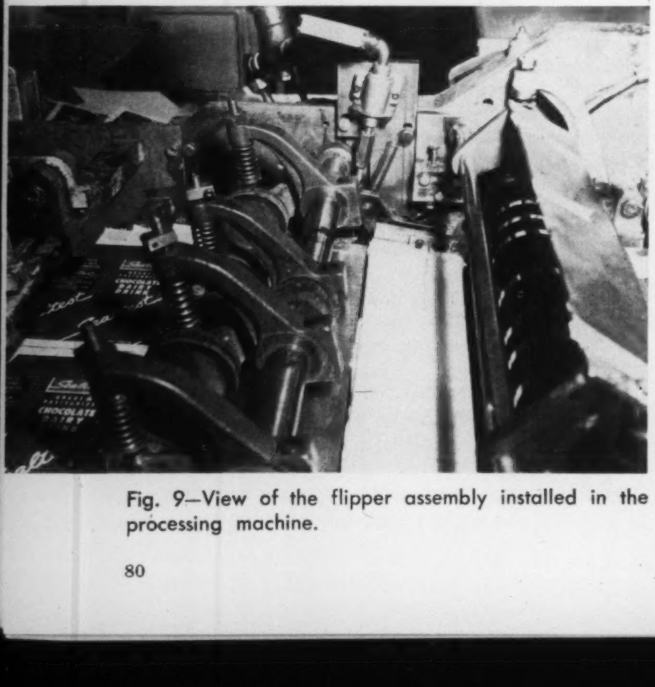


Fig. 9—View of the flipper assembly installed in the processing machine.

The flipper mechanism is subject to all of these restrictions as well as a few peculiar to its own operation. The problems peculiar to flipper action are:

1. The nose of the flipper must not lie in the web line at the instant the leading edge of the blank arrives since this results in an immediate jam.
2. A blank partially over or under the flipper at the time it is actuated cannot be jarred too sharply since this will cause the leading edge of that blank to miss the nip of the following set of rolls, resulting in a jam.

The present flipper mechanism has evolved from three basically different designs which preceded it. Its successful operation is based upon its location in the process line, the configuration of the flipper and adjacent equipment, and the snap action with which it opens and closes. It has not been necessary to phase the flipper action to the cut-off knives.

Additional Control Features

Now that the basic system has proved itself on a production basis, certain refinements are being added. For example a manual eject switch has been added to the system which enables the machine operator to reject any material he knows to be defective. Poor printing will account for most of the material rejected by means of this switch.

Each time the process line is stopped, the printing stations are moved out of contact. This results in several feet of paperboard not being printed as it passes through the printing station at the time of the stop. Also, the paperboard in the drying oven at the time of the stop is often destroyed by being heated past its critical temperature. For these reasons, it is desirable to reject the partially processed paperboard in the line at the time the machine is stopped. A circuit which automatically rejects a given number of blanks at the beginning of each run cycle, regardless of the length of the previous run cycle, has been incorporated in the system.

Details of this installation serve to illustrate the advantages available when engineers of an operating company team up with specialists to apply the techniques of automation in an effort to achieve a better product at less cost.

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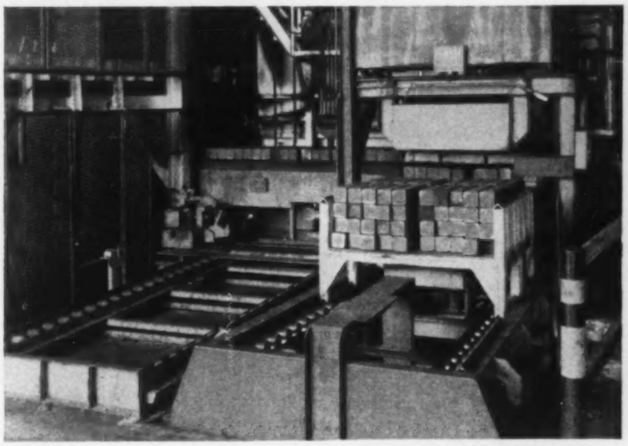
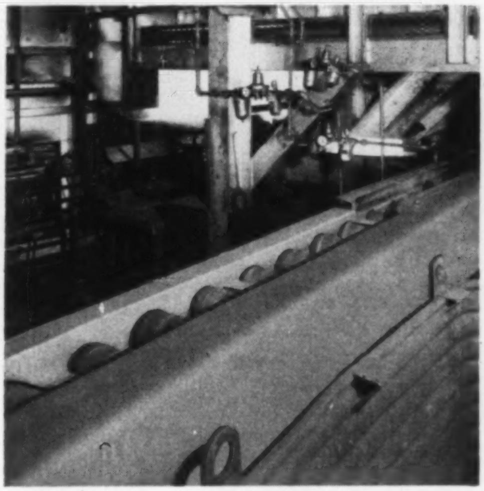
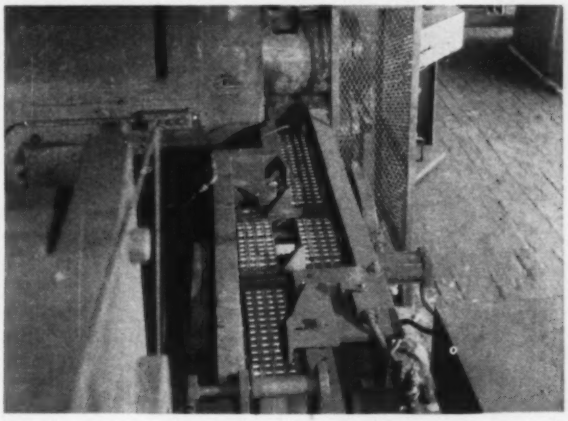


In this system, which was recently installed in a large automotive forge plant, a steady flow of billets is insured by the automatic rack unloader. This unit feeds billets automatically into the furnace and moves empty racks away for pick-up.



Hot billets are carried rapidly and in a continuous flow from furnace to the first reducer roll by a powered roller conveyor.



From reducer rolls hot billets are moved to presses, and enroute are turned by roller chain repositioning unit.

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(Left to right) Dr. John Bardeen*, Dr. William Shockley* and Dr. Walter H. Brattain, shown at Bell Telephone Laboratories in 1948 with apparatus used in the early investigations which led to the invention of the transistor.

Bell Telephone Laboratories Salutes Three New Nobel Prize Winners

Drs. John Bardeen, Walter H. Brattain and William Shockley are honored for accomplishments at the Laboratories

The 1956 Nobel Prize in Physics has been awarded to the three inventors of the transistor, for "investigations on semiconductors and the discovery of the transistor effect."

They made their revolutionary contribution to electronics while working at Bell Telephone Laboratories in Murray Hill, N. J. Discovery of the transistor was announced in 1948. Bell Laboratories is proud to have been able to provide the environment for this great achievement.

This is the second Nobel Prize awarded to Bell Telephone Laboratories scientists. In 1937 Dr. C. J. Davisson shared a Nobel Prize for his discovery of electron diffraction.

Such achievements reflect honor on all the scientists and engineers who work at Bell Telephone Laboratories. These men, doing research and development in a wide variety of fields, are contributing every day to the improvement of communications in America.

**Dr. Bardeen is now with the University of Illinois, and Dr. Shockley is with the Shockley Semiconductor Laboratory of Beckman Instruments, Inc., Calif.*

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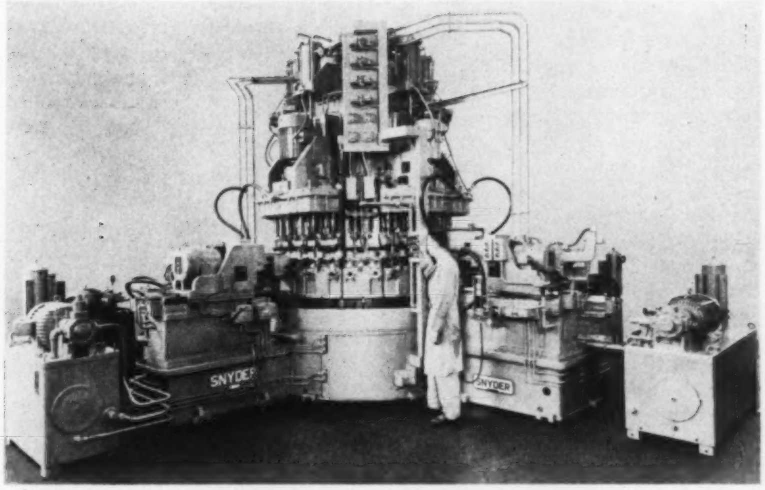

Processing Steering Gear Ball Nuts

A 16-station center column machine featuring a heavy duty seven-sided column that resists high machining thrust loads is designed to drill, ream, countersink, chamfer and ream automotive steering gear ball nuts at a net production rate of 331 pieces per hour. The machine has a 96-inch diameter index table. With its control panel, it occupies a 24 by 26-ft floor space and is 13 ft high overall.

Three long steel ball nuts are clamped in each of the 16 fixtures on the machine. The nuts, which have previously machined rack teeth in the blanks, are located in the fixtures from these rack teeth. Hydraulic clamping means are provided for the parts. Large vertical thrust loads, which make the heavy duty center column design necessary, are imposed by two three-spindle, two nine-spindle, one 12-spindle and one 18-spindle vertical heads that drill, flat bottom drill and radius chamfer four recirculating ball holes as well as tap drill and chamfer one hole in the same part face. **Snyder Tool & Engineering Co.**, 3400 E. Lafayette, Detroit 7, Mich.

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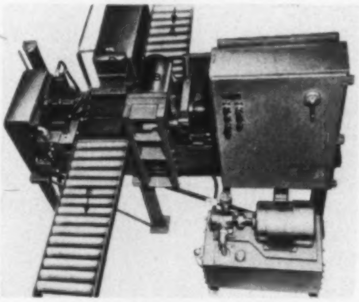

Serial Numbering Unit

Requiring only 6 seconds to perform an entire marking operation, automated serial numbering machine processes transmissions and other parts. As shown in the photograph, the automated machine receives transmissions over a roller conveyor (A) which, by gravity, delivers the parts to position against the spring cushioned stop (B) where, on contact, a limit switch starts the automatic marking operation. Cases are then moved to the numbering head (C) which performs the serial numbering operation, after which the ejector (D) pushes marked cases onto another roller conveyor (E), over which the part travels to rejoin its cycle of manufacture. Time savings are obtained through the elimination of manual operations previously required for the placing of parts in a numbering machine during the production cycle. **Cadillac Stamp Co.**, 17315 Ryan Rd., Detroit 12, Mich.

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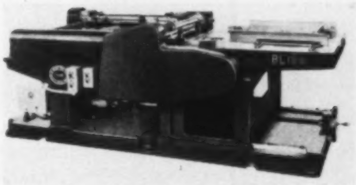


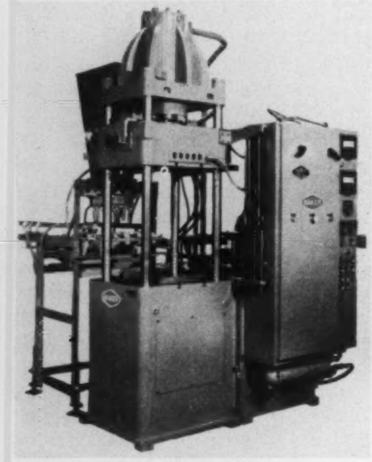
Can Trimmer and Slitter

Developed for high speed can lines, duplex trimmer and slitter is a two-unit machine mounted on a common base and driven in unison by a geared head motor. Capable of speeds ranging from 30 to 70 sheets per minute depending on the cuts required, Model 5225 may be used to trim and square up tin plate for lithograph presses and can machinery, or to trim and slit sheets into blanks for a bodymaker.

A feature of the machine's design is that the bearing housings can be removed without dismantling the rest of the slitter. The housings, bearings and sleeves are removed as a unit, freeing the cutters and reducing downtime during changes or adjustments. Cutters can be sharpened in place, saving time on every regrind. The first operation table is moved back 20 inches on gibbed ways, providing access to the first set of cutters. For the second set, the motor driven grinding attachment is bolted directly to the machine.

Other features include heavy 3-inch diameter slitter shafts, life-lubricated bearings and cast Meehanite base and frame. **E. W. Bliss Co.,** 50 Church St., New York 7, N.Y.

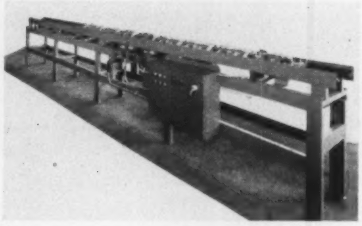
Circle 403 on Inquiry Card



Molding Machines

Available in a new 60-ton model, fully automatic plastic compression molding machines allow selection of the shortest cycle for any molding job. Close, decelerate, breathe and open are all adjustable by setting timers and cams. Automatic loading on the presses is quickly adjustable for different molds. Compression molding machines are available in capacities up to 450 tons. **Baker Brothers Inc.,** Toledo 10, O.

Circle 404 on Inquiry Card



Shuttle Conveyor

Used to transfer intake manifold castings from one production machine to another, 24-ft long shuttle transfer conveyor is powered by an electromechanical drive assembly. Conveyor holds 14 castings which weigh approximately 40 lb each, and delivers them to a preload station of the transfer machine which it feeds. The speed of the transfer conveyor is designed to be twice the speed of the transfer machine in order to keep the preload station of the transfer machine loaded, even though an empty space may be left on the transfer conveyor by the machine which feeds it.

The electromechanical drive assembly utilizes an electric motor for shuttling a ball bearing nut, on a suitable screw at a specified speed. The ball bearing nut is connected to a conventional shuttle bar, equipped with collapsible dogs. The dogs push the manifold along steel ways on their forward stroke and collapse under the manifold on their return stroke. At the end of the return stroke the dogs right themselves again to push the manifolds forward on their forward stroke. Conveyor eliminates the need for air cylinders, oil cylinders, pumps, air and oil piping with its consequent control valves and solenoids. **Spurgeon Co.,** 23501 Hoover Rd., Van Dyke, Mich.

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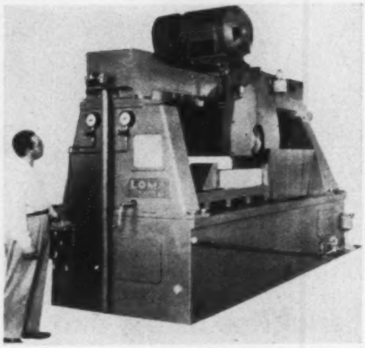
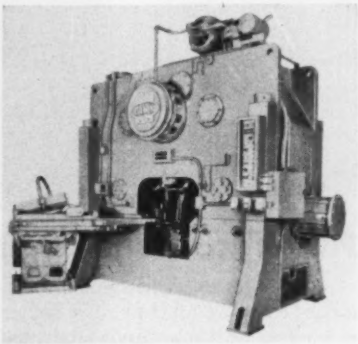


Automatic Hydraulic Saw

Developed for cutting heavy ingots, automatic saw features a saw carriage which travels on a cross beam above the ingot. This arrangement protects the moving parts, such as motor, carriage, saw blade drive and feed cylinder, from chips. The saw also incorporates features which are helpful when cutting heavy ingots. The feed tables can extend close to the saw blade; clamps are easily arranged on either side of the blade enabling short, last and first ends to be cut. A mechanized chip conveyor may be placed below the saw blade for automatic chip removal. The operator is protected against flying particles by being stationed behind the wide cross beam support and observing the cutting through a window. The entire operating cycle is remote controlled and all adjustments can be made from the operator's stand. **Loma Machine Mfg. Co.,** 114 E. 32nd St., New York 16, N.Y.

Circle 406 on Inquiry Card



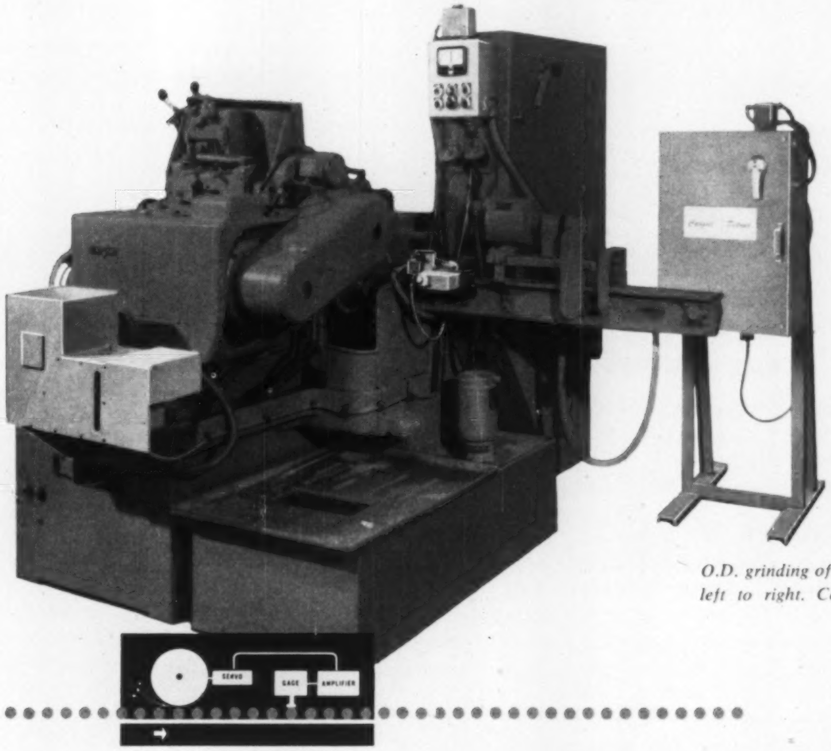
Dual Slide Extruders

Two 100-ton mechanical presses which are called dual slide extruding machines feature two slides for exerting horizontal pressures required to extrude piston pins approximately 3¼ inches long for truck engines. Each press is completely automatic. Net productive capacity of each is approximately 2500 pieces hourly. An attached hopper supplies short lengths of bar stock to the feeding mechanism for extruding to size, including inside diameter and length. As illustrated, the hopper at the left automatically feeds raw material into the automatic extruding and ejecting mechanism. Piston pins exit in the rear area. **Danly Machine Specialties Inc.,** 2100 S. Laramie Ave., Chicago 50, Ill.

Circle 407 on Inquiry Card

Presenting . . .

Continually Correcting
AUTOMATIC SIZE CONTROL
For Your Grinders *(patents pending)*



O.D. grinding of automatic valve lifters. Parts move from left to right. Conveyor feeds the following operation.

Your O.D. grinding can now be automatically controlled *with smooth, continual, positive correction* – an advantage never before available in a size control.

Correction occurs for *every* piece, proportional to *any* deviation from nominal size. Thus, the "saw tooth" size sequence, which is unavoidable either with an operator or conventional controls that jog between high and low limits, is wholly absent.

This approach gives a hitherto unattainable accuracy.

This Cargill Detroit Size Control is already in use. It can be applied to all standard grinders including Cincinnati #2 machines – both ball and plain slides.

Literature is available on request.

CARGILL · DETROIT *Corporation*

Designers and Builders of Automatic Manufacturing
2254 Cole Avenue Birmingham, Michigan

Established in 1949

(The gaging components used are members of the family of standard Cargill Detroit automatic control and gaging equipment.)

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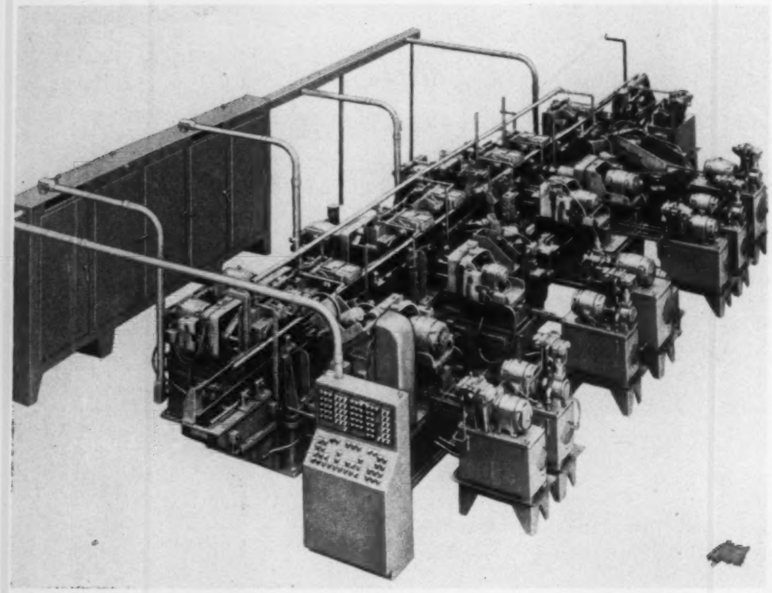


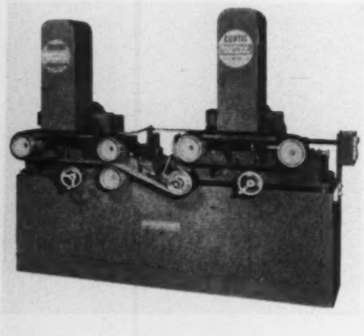
Transfer Machine for Torque Converter Housings

Sixty-two operations are performed per hour on 200 torque converter housings by new 12-station, 42 ft long machine. Sectionalized bases to simplify processing changes, automatic depth inspection of all holes before tapping, automatic lubrication of all moving parts, mist lubrication to all spindles to maintain uniform temperature in the heads, and all spindles arranged for presetting of cutting tools are some of the features of the machine.

Operations include: 36 drilling, two combination drilling and reaming, seven countersinking, two reaming, one boring, seven inspection and seven tapping. The 12 stations are: one for loading, seven for machining (including one for mechanical inspection), three for visual inspection, and one for unloading.

Other features are: tapping spindles of the individual lead screw type with precision ground and hard-chrome plated threads, and multiple heads of Buhr ball bearing construction with shaved gears and broached and splined drives. **Buhr Machine Tool Co.,** Ann Arbor, Mich.

Circle 408 on Inquiry Card



Double-Side Grinder

Automation in the grinding, polishing and deburring field is made possible with Model 304C2 double-side grinder. Incorporating a turnover transfer unit between conveyorized abrasive belt heads, the machine grinds, polishes or deburrs both sides of a workpiece in one handling of the stock. The turnover mechanism allows grinding and polishing of pieces of different sizes and shapes. It can be engineered to accommodate almost any piece.

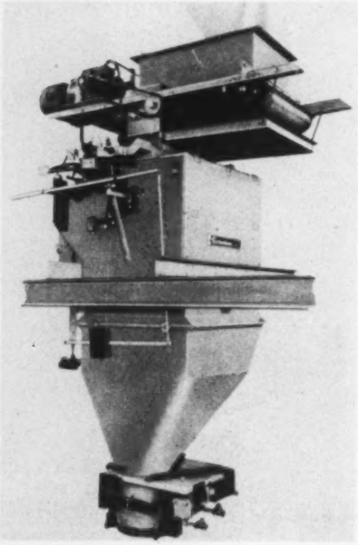
The grinder uses abrasive belts 4 inches wide by 54 inches long and incorporates a $1\frac{1}{2}$ hp abrasive belt motor and two $\frac{1}{2}$-hp infinitely variable-speed conveyor drives. **Curtis Machine Corp.,** Jamestown, N.Y.

Circle 409 on Inquiry Card

High Speed Bagging Scale

Bags of 25, 50 and 100 lb are sacked at rates up to 15 bags per minute by power driven, belt fed bagging scale. Called Model GA-38, the scale is designed to handle all dry feeds, including grains, crumbles, pellets, range cubes and molasses feed. Dustproof construction of the scale makes it particularly suitable for handling dusty materials.

Bagging rates of 12 to 15 bags per minute for the 25 or 50-lb bags, and 12 bags per minute for 100-lb bags are possible with the unit.



Weighing accuracy tolerances are ±0 to 3 oz on most materials, although range cubes and similar difficult materials produce nominal deviations.

In operation, the scale receives material from a 22-inch belt feeder, powered by a motor with built-in brake. An inlet gate below the scale's head pulley closes as the weigh beam approaches balance. This opens the feeder's motor drive circuit. The unit can be automatically or manually discharged. When operated with an optional solenoid discharge, the scale discharges by placing a bag on the spout and closing the bag holder. The GA-38 can be supplied as a two-scale model, providing greater output and equal weighing accuracy. **Richardson Scale Co.,** Van Houten Ave., Clifton, N.J.

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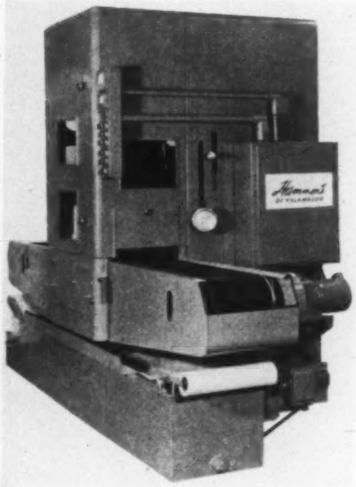

Flat Finisher

Designed for wet abrasive belt grinding, polishing and deburring of flat work such as sheets, strip, bars, stampings, plates, etc., up to 12 inches wide and 6 inches high, flat finisher is designated Model FF-12. Continuous feeding of work is accomplished through use of a variable speed air-tensioned endless conveyor.

The head of the machine is of two-roll design, employing an abrasive belt 12 inches wide by 126 inches long. It consists of a large diameter air-tensioned tracking idler pulley, a heavy dovetail slide for work height adjustment and a contact roll driven by a motor rated up to 25 hp. Other features and optional equipment include power elevation for head adjustment to the work, 6 to 10-inch diameter contact rolls, adjustable work holddown rolls, magnetic conveyor platen and automatic coolant filter. **Hammond Machinery Builders Inc.,** 1650 Douglas Ave., Kalamazoo, Mich.

Circle 411 on Inquiry Card

Pulse Code Telemetering

Used to maintain close control of the flow of petroleum products, Varec system not only supplies remote liquid level telemetering and supervisory controls but also handles data recording at predetermined intervals. The additional function is possible by supplementing the pulse code receiver with

AUTOMATE YOUR METAL CLEANING!

. . . Call On DETREX

Eliminate slow and costly manual handling and keep your metal cleaning processes in step with production.

Detrex Engineers have years of experience in the design and manufacture of quality automatic equipment . . . degreasing — washing — phosphate coating. Let this experience provide you with modern, automatic metal cleaning built right into your conveyor lines.

Also, Detrex Ultrasonic Soniclean Process has been incorporated into many continuous production lines.

Mail the coupon for complete information on Detrex equipment, or check your Sweet's Plant Engineering File.

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DEGREASERS • DEGREASING SOLVENTS • WASHERS • ALKALI AND EMULSION CLEANERS • PHOSPHATE COATING PROCESSES

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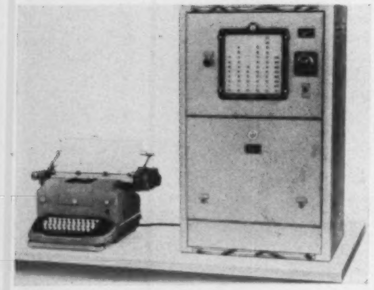
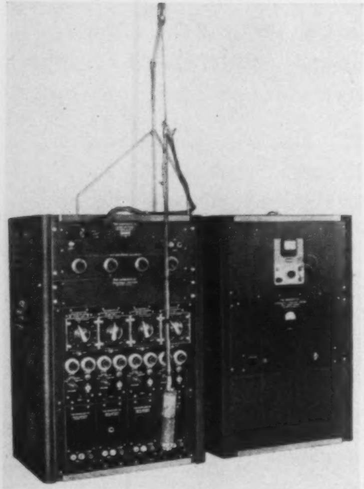


converter equipment to operate a solenoid actuated typewriter unit. Thus data is logged to permit accurate inventory control and the printed report can be used by the accounting department. Automatic scanning is another available feature of the system. With this feature, liquid level, temperature, date and time are reported tank by tank, sequentially, until an entire tank farm has been covered. Remote temperature recording of either spot or average temperature of the liquid contents of a tank is another function of the system. **Vapor Recovery Systems Co.,** 2820 N. Alameda St., Compton, Calif.

Circle 412 on Inquiry Card

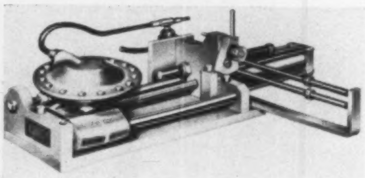


Capacitor Tester

A production go—no-go tester that is designed for adaptation to automated production lines or manual operation simultaneously measures capacitance and equivalent series resistance of any single or multiple section electrolytic ranging from 2 to 5000 mfd with equivalent series resistance of 0.4 to 400 ohm. Accuracy is ±2 per cent on capacitance and ±3 per cent on resistance. The tester measures at 60 or 120 cycles. Capacitance tolerance span is fully adjustable within −20 per cent to 300 per cent of nominal. Resistance tolerance is adjustable through the full range of 0.4 to 400 ohm.

The standard unit indicates quality of capacitor through signal lights and gives simultaneous dial indication of capacitance in per cent of nominal for each section of the capacitor under test. An operator manually manipulating the test probe can check approximately 1900 four-section electrolytics per hour. **Magnavox Co.,** Dept. NP, 2131 Bueter Rd., Fort Wayne 4, Ind.

Circle 413 on Inquiry Card

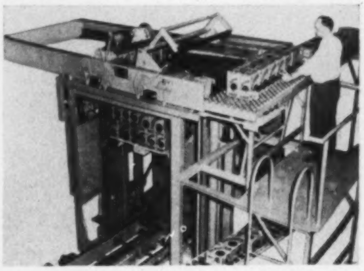


Coiled Stock Feeders

Used for feeding coiled stock into punch presses, mobile air-operated feeds can be moved easily from press to press. Units are designed for direct mounting to the bolster plate of the press. With the feeds, the only other tie-in necessary with the press is the mounting of a valve so that it will be tripped by some moving part of the press ram or die. Available for maximum stock widths of 8, 12 and 18 inches, and maximum feed stroke lengths of 8, 12 and 18 inches, the air feeds are adjustable for both width and stroke length from their maximum to zero.

In performance, the coiled stock being fed is guided at both the front and rear of the air feed. On a signal from the press, a diaphragm gripper assembly connected to the end of the feed cylinder and guided on rigid bars, grips the stock with approximately 1600 lb pressure along one edge of its width. The diaphragm gripper then pulls the stock forward to the end of the feed stroke where it is released. During the return of the head, the stock is retained securely and prevented from slipping by a self-adjusting mechanical stock retainer. The stock is always fed on the up stroke of the press. **Special Engineering Service Inc.,** 8161 Livernois Ave., Detroit 4, Mich.

Circle 414 on Inquiry Card



Pallet Loader

Designed for the stacking of containers onto pallets, semiautomatic pallet loader consists of a series of mechanical, electrical and pneumatic components. In operation, pallets are loaded into the machine in stacks by fork trucks, and are then automatically passed through one at a time, are loaded with containers, and then discharged to the fork truck pickup section of the machine for handling into storage.

Containers are received from a conveyor line, arranged into layers by an operator, and placed on the pallet in a predetermined number of layers. Loader may be divided into three parts: Empty pallet handling equipment, full pallet handling equipment, and carton handling equipment. Empty pallet handling equipment consists of a pallet dispenser with its controls interlocked with the pallet loading machine. Full pallet handling equipment consists of the full pallet lift, the discharge chains and the fork truck pickup section. The carton handling equipment consists of the ball transfer receiving and arranging table and the accumulation conveyor apron.

Carton handling equipment is electrically actuated and controlled by the operator. Pallet handling equipment is electrically controlled automatically. **Mathews Conveyer Co.,** Ellwood City, Pa.

Circle 415 on Inquiry Card

Electronic Gage Units

Consisting of a small electronic pickup cartridge called the Electrojet, for incorporating in new and existing gages and precision instruments, and a portable electronic amplifier called the Accutron, new electronic units are well suited for size sensing gaging devices, machine controls and precision measuring instruments. Electrojet is a transducer type pickup unit 3/8-inch in diameter by 1 7/8 inches long. Teamed with the Accutron the units provide accurate, high speed indication of part size over a wide tolerance range.

The amplifier is available with dual amplifications of either 1000/2000; 2500/5000; 5000/10,000; 10,000/20,000; or 20,000/40,000 to 1. Amplifications within each dual range can be switched from one to another without realignment of the indicating meter mechanism.

Electrojet gage cartridge has a total stylus travel of approximately 0.110-inch. Pretravel is approximately 0.005-inch. The same unit can be used with all amplifications. No pickup calibration is required; calibration is accomplished by fixture setting only. A positive stop at the end of the plunger overtravel protects the unit against damage. **Sheffield Corp.**, Dayton 1, O.

Circle 416 on Inquiry Card

Ring Gear Marker

Fitted for marking on the periphery of ring gear blanks, new machine is designated Model 175-S. Parts are rolled into a feed

FROM THEN...
...TO ETERNITY
1924
The U. S. Drill Head Company's first Fixed Center Drill Head was produced for Borg and Beck, of Chicago — a subsidiary of Borg-Warner.

1957

The 50,000th Head was shipped.

For men who know drill heads best, it's always U. S. Drill Head ...5 to 1

Since 1915, when the U. S. Drill Head Co. built its first adjustable head, it has far surpassed all other similar manufacturers because of its engineering and production facilities.

Manufacturers of all types of adjustable, fixed center and individual lead screw tapping heads.

US DRILL HEAD
THE UNITED STATES DRILL HEAD COMPANY
BURNS STREET • CINCINNATI 4, OHIO

Circle 579 on Inquiry Card

you can
DIAL your
ADJUSTMENT
on this
AGASTAT®
time/delay/relay
AGASTAT
AGA
Frequent time adjustments are no problem with the dial head available on AGASTAT time/delay/relays. They provide a complete range of adjustment with 1 revolution of the dial. Dial markings permit easy calibration for accurate adjustment. And you can spot each of the 4 timing ranges quickly because they are color coded: blue from 30 seconds to 15 minutes; red from 10 seconds to 2 minutes; yellow from 0.1 to 10 seconds; white from 0.1 to 3 seconds.

Like all AGASTAT relays, units with dial heads are solenoid actuated, pneumatically timed. Each model is available with either dial head or needle valve adjustment. Where frequent readjustment of timing is necessary, dial head adjustment should be specified. For bulletin on all popular AGASTAT time delay relays, write to: Dept. A28-123.

AGA DIVISION
Elastic Stop Nut Corporation of America
1027 Newark Avenue, Elizabeth, New Jersey
Pioneers in pneumatic timing

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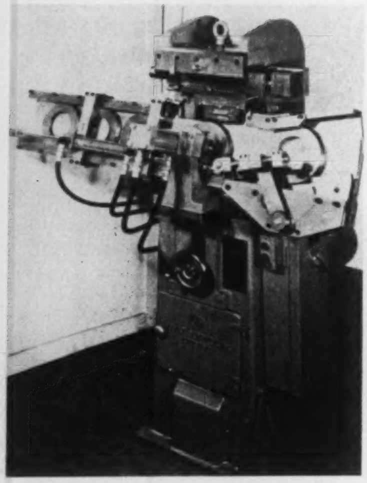


chute at the right of the machine from the preceding operation, from which they are guided into position at the marking station. They are stopped at this point for an instant, during which time a hydraulic stud slips through the bore, thus supporting the gear. Simultaneously, the arbor raises the gear to marking position as the die slide, carrying the lettering tool, starts forward. After marking, the supporting arbor lowers and recedes. A hydraulic arm engages the gear in the bore, carrying it to the discharge chute at the left.

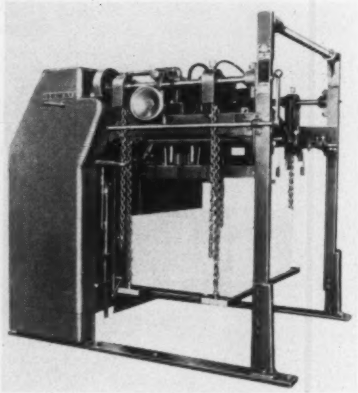
The entire operation is automatic. Serial numbering or fixed lettering, or both, can be incorporated in the marking tool. The illustration shows an operation for temporary interplant marking, prior to actual gear cutting. The final marking operation is performed in a similar unit after the last machining operation. **Geo. T. Schmidt Inc.,** 4108 Ravenswood Ave., Chicago 13, Ill.

Circle 417 on Inquiry Card

High Speed Sheet Feeder

Redesign of 6000-lb capacity metal sheet feeder permits handling of sheets at a continuous rate up to 125 per minute throughout multishift operating schedules. Machine withstands strains of operating at high speeds for long periods. Feeder automatically separates, lifts, calipers and advances sheets up to 44 by 48 inches in size to the registering or feeding station of the press, coater, slitter, shear or other machine to which it is attached. Tinplate, black iron or other metal sheets may be fed in thicknesses ranging from 38 to 20 gage, while special optional features can extend the range to 18 gage.

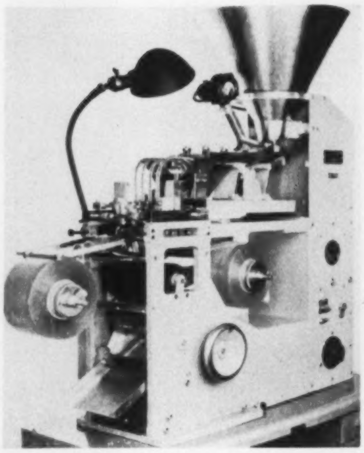
Feeder can be equipped for either rear or side loading. Pile position is adjusted by a manually operated shifter bar on the elevator while a pile height governor automatically maintains the top sheet of the pile at exactly the right level for precision feeding. Sheet separation is accomplished by timed suction cups and blasts of filtered air, aided by permanent magnets when ferrous material is being run. Double, wrinkled or damaged sheets are diverted from the feed line without stopping by means of mechanical fingers which caliper each sheet and carry rejected ones to a tray above the conveyor. For reloading, a fast lowering elevator drops to reload position in approximately 20 seconds to allow reload forks to position a new pile on the elevator. Six basic types of conveyor are available, including plain or telescopic belt conveyors with or without cam operated sheet slow-down. **Dexter Folder Co.,** Pearl River, N. Y.



Circle 418 on Inquiry Card

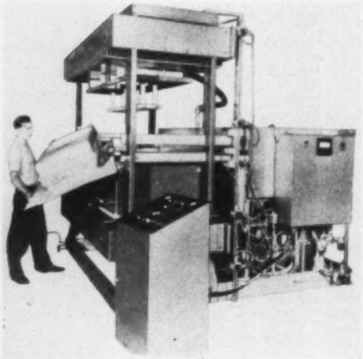
Strip Packaging Devices

Designed to strip package a variety of tablets, capsules, or other objects, singly or in multiples, at approximate speeds of 800 per minute, new machines are available in two models—Model E straight line feed packager, and Model R rotary feed machine. Both use various heat sealing films such as cellophane, foil, etc., in widths up to 5½ inches.



Machines are compact—22 inches wide, 42 inches long and 44 inches high, and may be set on a bench or stand. Pharmaceutical and other round products 1/16-inch to 1 inch in diameter or more, or oblong, oval and other shapes can be packaged. Dies of any circumference between 6 and 9 inches can be supplied, making it possible to manufacture packages of exact dimensions desired. Changeover between different die sets can be performed easily. Removable cartridge type heaters with an adjustable temperature controller heat the dies to the desired temperatures for heat sealing different films. **de Florez Co. Inc.,** 116 E. 30th St., New York 16, N.Y.

Circle 419 on Inquiry Card



Plastic Forming Press

Forms that are hard to fabricate due to shape or material thickness can be processed easily with forming press called the Star. New forming techniques incorporated into the machine include: Snap-back forming, pressure forming, mechanical forming, and vacuum forming and trimming in one operation. Basic operation consists of the automatic withdrawal of a superheated plastic sheet from an enclosed oven. Heating of the plastic sheet evenly on two sides greatly reduces cycle time.

Automatic cycling operations are preset in special timers. Loading and unloading operations may be by manual means, from extruder, or blanks automatically fed and automatically removed after forming. Machine is equipped with counteracting platens which provide for plug assist or hold-back directing control on the plastic sheet during forming operations. Each platen is capable of carrying a mold or helper and performs a complete fabricating operation. Vacuum may be applied through either or both platens simultaneously, depending upon forming technique desired. On the press the sheet is securely clamped in a central position between the two platens. Each platen is electrically driven and individually controlled to and from the forming area. **Comet Industries,** 9865 Franklin Ave., Franklin Park, Ill.

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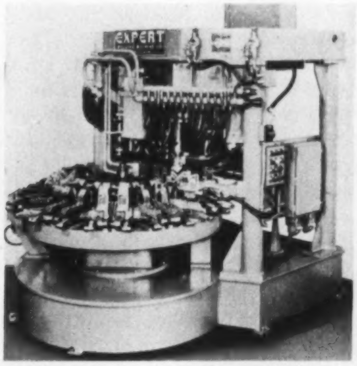
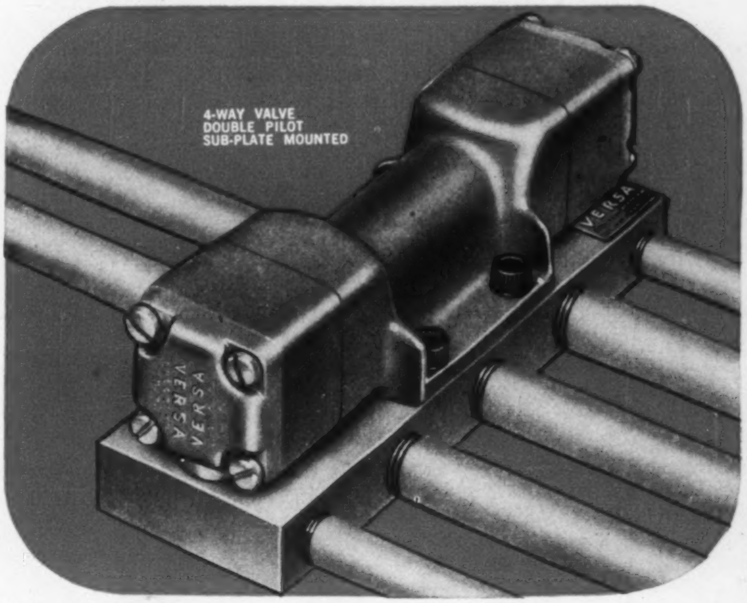


Index Welder

Featuring a continuous running cam drive which controls index and weld sequences, 12-station index welder simplifies sequence timing functions, since the welds are made when the 5 rpm cam is in dwell position. Illustrated machine welds 1200 two-piece, right

FOR MAXIMUM CAPACITY IN MINIMUM SPACE . . .



THE VERSA MANIFOLD MOUNT VALVE

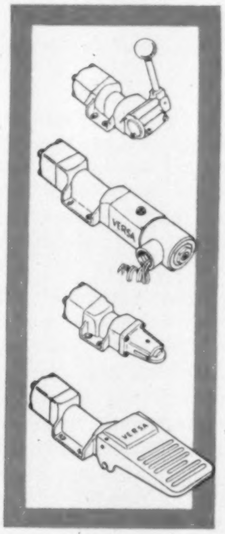
The **Versa Manifold Valve** has been especially designed for use where space is at a premium.

All piping can be installed, connected to manifold plate and even purged before installation of the valve itself. The valve is then simply bolted into place on the manifold plate. The valve proper, being independent of the piping, can be easily removed for service or replacement without disconnecting piping or disassembling the valve.

Versa Control Valves are available with any type of actuating device in sizes from ⅛" to 1" NPT, in 2-, 3-, 4-, and 5-way type, and for pressures from partial vacuum to 500 PSIG.

All Versa Valves are triple pressure and functionally tested under water for guaranteed leakproofness.

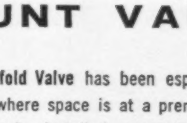
Over 110,000 Variations . . . Ready for Immediate Delivery!



VERSA

VERSA PRODUCTS COMPANY INC.
248 SCHOLES STREET
BROOKLYN 6, N. Y.

The entire line of VERSA valves is explained in our new comprehensive Folder #14



Circle 581 on Inquiry Card

and left hand automotive hood hinge stampings together per hour with nine spot welds. Both right and left hand parts are welded on the machine in adjacent fixtures on the 6-ft diameter index table. The parts are clamped in the 24 fixtures by stationary air-operated clamps at the welding stations. Both transformers and hydraulically powered welding guns for the four weld stations are suspended from an upper platform supported by four tubular steel columns.

Since both right and left hand parts are welded on the machine, air-operated ejector mechanisms are provided at separate stations to separate the right from the left hand parts and deposit them on individual conveyors. A part detector mechanism checks each fixture for load condition at a station ahead of the weld stations and shuts off the machine if no part is in the fixture. **Expert Welding Machine Co.,** 17144 Mt. Elliott Ave., Detroit 12, Mich.

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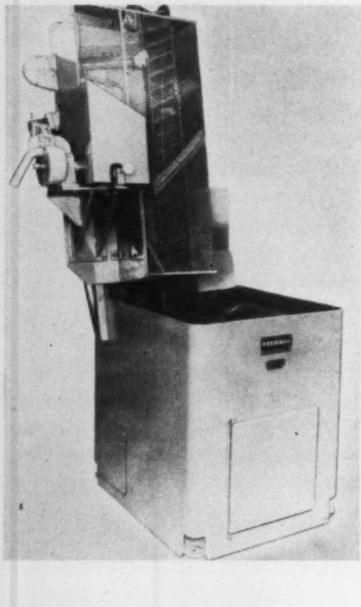


Trunnion Cup Feeder

Utilizing Model 2200-B elevating hopper feeder with a 4 cu ft hopper capacity as the basic feeder, new machine feeds trunnion cups to a centerless grinding operation. With the improved transfer mechanism, the trunnion cups are moved from rolling position to sliding position by an intermittent motion, and fed into an electrically controlled gravity chute. From there they are fed into the grinder at a continuous rate. The complete package consists of a storage hopper, conveyor, orienting-selecting mechanism, transfer mechanism and discharge chute.

Work range for rolling parts is 3 inches in diameter by 3/16 to 1 inch in length; for sliding parts, 3/16 to 1 inch in diameter by 3 inches in length. **Feedall Inc.,** Willoughby, O.

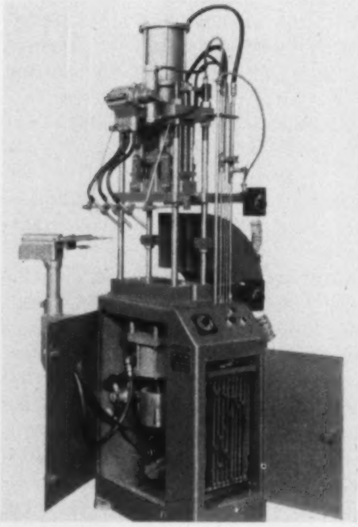
Circle 422 on Inquiry Card

Newsprint Roll Clamp

Designed to facilitate loading and unloading boxcars and trucks, paper roll clamp has high strength and rigidity, and high clamping force without high pressure. One arm is fixed to the clamp body and the other is moved by two hydraulic cylinders to insure adequate clamping force with low pressure. The fixed arm is short. The movable arm pad extends beyond the center of the roll, permitting picking up horizontal rolls from the floor without having to chisel under the roll. The load pads extend beyond the body of the clamp and the clamp arms, so there is no interference when approaching rolls diagonally. The pads are 30 inches wide and braced against distortion which could reduce clamping force.

Clamp rotates continuously 360 degrees in either direction, and can handle rolls from 32 to 44 inches in diameter. It is equipped with hydraulic pilot check valves and a hydraulic accumulator to prevent loss of clamping pressure. **Baker Raulang Co.,** 1250 W. 80th St., Cleveland 2, O.

Circle 423 on Inquiry Card



25-Ton Molding Press

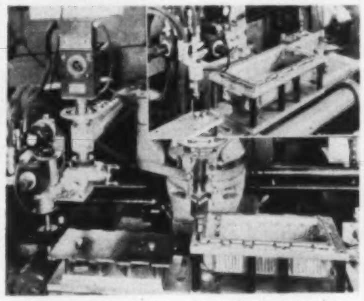
Designed for use on short production runs where low mold costs, quick mold setup and automatic molding are desired, 25-ton air operated compression molding press is designated Model 725. Unit can be equipped with a universal chase plate which permits cavities to be changed quickly without taking the chase plates from the press. It also has an easily adjustable three - station rotary feeder, a separate cam actuated air ejection system, and an air operated pushoff which can be sequenced in any point in the press open cycle. Either top ejection or bottom ejection with top holddown is possible, with maximum ejection stroke of 2½ inches.

The bar controller provides for fast and easy changeover in the molding cycle to accommodate bumping, breathing and multiple air blast. Movable buttons are placed on the graduated vertical bars. These buttons are tripped in sequence from top to bottom by a horizontal bar which moves on an endless chain. As each button is tripped, motion from the vertical bar actuates a limit switch which in turn controls one of the motions of the press. All press motions are controlled in this manner with the exception of the dwell under pressure while the parts being molded are curing. Calibrated control of the press is thus provided by the movement of these buttons on the graduated bars. Buttons can be reset in seconds to provide cycle modifications. When settings are recorded, cycle requirements can be reset to meet requirements of various dies or molds that are used in the machine. **F. J. Stokes Corp.**, 5500 Tabor Rd., Philadelphia 20, Pa.

Circle 424 on Inquiry Card

Tracer Control System

A closed two-dimensional or 360-degree contour is reproduced automatically by magnetic sensing type stylus tracer control system. No control action is required on the part of the operator other than predetermining maximum feed rates. The unit features an adjustable tracer and feed speed range that will remain constant along any 360-degree contour during tracing operations.



Adaptable to a standard milling machine, the tracer control movements to saddle and table are through hydraulic cylinders. The tracer valve is mounted in a vertical plane in direct relation to and parallel with the axis of the vertical spindle. The tracer is mounted on a swivel type overarm which provides a wide range of setting between the tracer and the vertical spindle to accommodate workpieces that can be machined within the conventional travels of the mills.

The tracer valve is equipped with a built-in selector that enables the operator to use the valve as an automatic 360-degree pencil type tracer control, allowing him to machine pockets of a predetermined depth using an oversized tracer stylus under hand control, and then to finish out the periphery of the pocket utilizing the automatic control feature. **Turchan Follower Machine Co.**, 8259 Livernois Ave., Detroit 4, Mich.

Circle 425 on Inquiry Card

From central storage and mixing rooms, 70 Binks material handling pumps send automotive finishes through a 12 mile paint circulating system in the Ionia Manufacturing Division of The Mitchell-Bentley Corporation, Ionia, Mich.

At the largest independent producer of automotive bodies...

Scores of matched auto finishes always ready in each spray booth

At Ionia you'll see station wagon bodies for two General Motors Divisions and one Ford Division, plus trim and sub-assemblies for Studebaker-Packard, American Motors, Chevrolet and the Fisher Body Division of GM in all stages of production.

Positive control of finishes
A paint circulating system utilizing 12 miles of pipe provides close color and viscosity control over all finishes, which are prepared under laboratory conditions in central paint rooms. Each color has its own tank from which it is circulated to each spray station and back to the tank. This assures identical finishes at each spray gun in the plant.

Maximum finish flexibility
A Binks paint circulating system permits almost instantaneous change of colors and finishes. Spray guns can be quickly detached from one line and connected to another or a different gun can be used for each finish.

Trouble-free operation
Binks new precision air-operated material handling pumps are ideal for systems of this kind. Their ruggedness assures trouble-free service. Any hazard of electrical connections is eliminated. Volume and pressures are easily controlled. Both original and operating costs are low.

For complete information
about Binks paint circulating systems, send for Bulletin 701...or better still, call in a Binks engineer for suggestions that meet your requirements. Contact your nearest Binks Branch Office or write direct to the address below.

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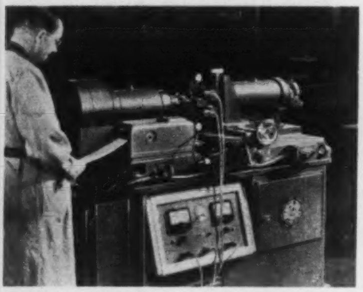


Automatic Gear Checker

Used to inspect aircraft and similar types of precision spur gears, Model 481 automatic machine checks for parallelism and tooth spacing and provides a permanent record on the recorder chart. The unit can be used to inspect gears ranging from $\frac{1}{4}$ to $2\frac{3}{4}$ inches face width and from $\frac{1}{2}$ to 14 inches in diameter. The recorder chart is graduated in increments of 0.0001-inch, making it possible to obtain actual readings to even closer limits. The recording pens, actuated by the movement of the top and bottom carbide checking fingers, use different color ink to simplify obtaining required readings.

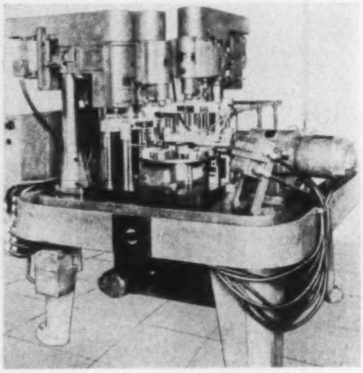
Approximately 5 seconds are required to check a tooth. If desired, every tooth need not be checked. The checker can be set to check any desired number or combination of teeth in any gear and skip the balance. Rubber shock mounts that isolate the work table from the base of the machine insure accurate readings unaffected by surrounding vibration, etc. An electric interlock prevents accidental operation of the automatic indexing while the lock pin is in contact with the gear tooth.

Gears are checked by the fingers moving in and out of contact with the teeth parallel to the axis. While the fingers are moving in and out of contact with the gear tooth, and returning to starting point in contact with the next tooth, the gear is automatically being indexed. Indexing is controlled by an index plate, with a separate plate required for each gear having a different number of teeth. Adjustable indexing drive compensates for the size of gear being checked and for different numbers of gear teeth. **Michigan Tool Co.**, 7171 E. McNichols Rd., Detroit 12, Mich.

Circle 426 on Inquiry Card

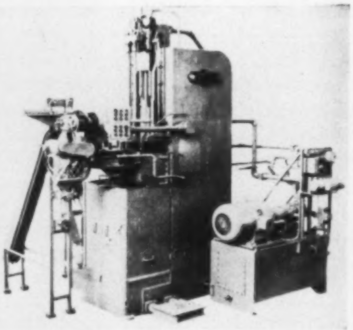
Driller and Tapper

Eight-station machine drills, taps, reams and deburrs an aluminum alloy diecasting. Every nine seconds ten holes are drilled, four deburred and two tapped on the four-way machine. The part which is processed is a plate-cast stator for the magneto of a small gasoline motor. The multiple drilling and tapping machine which consists of two standard vertical drill units, one vertical automatic lead screw tapping unit, and one horizontal drill unit was engineered to meet production requirements of 400 completed pieces per hour.



Assemblies are mounted on a standard cast iron machine base with built-in coolant tank and pump. Tooling for the part consists of an eight-station index table with eight nests to receive the part. The operator unloads one part and reloads another over two loading pins in the load station. He then presses a button which sends an electrical impulse to the index fixture. This indexes the loaded part to the workstations. Through a limit switch within the index, the four units are actuated simultaneously to perform the necessary drilling, reaming, deburring and tapping operations. After the machining cycle has produced one completed part, all units automatically return to start position and the cycle is repeated. **Ettco Tool & Machine Co. Inc.**, 594 Johnson Ave., Brooklyn 37, N.Y.

Circle 427 on Inquiry Card



Pull-Down Broaching

Built to provide maximum tooling flexibility and easy maintenance in vertical, internal broaching applications, pull-down broaching machine is electrically controlled and all components are interlocked to provide continuous automatic operation. The hydraulic systems are self-contained and are located outside the machine column. The unobstructed face of the heavy-duty column allows a wide range of tooling adaptation.

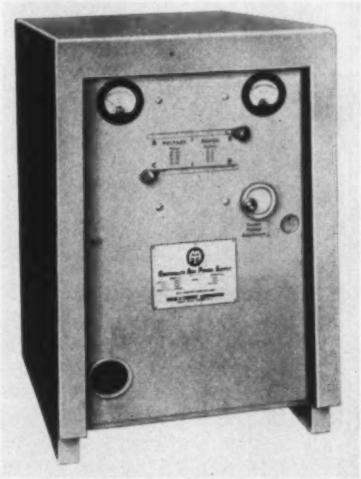
Worktable provides rigid support with minimum deflection for simple tooling as well as for the dial index type unit illustrated. Hinged splash guards under the table open completely to give clear access to broach puller assembly and coolant sump. The machine can be tooled with radially locked pullers, hydraulically actuated and electrically interlocked to the machine cycle, assuring that broaches are positively locked in the pullers before the machine cycle can continue. A further electrical interlock can be mounted on the retriever unit to assure proper positioning of broaches in the retriever heads during the broaching stroke.

Machine has provision for the adaptation of a chip conveyor, loading conveyor and work ejector for installations demanding fully automatic operation. Illustrated machine is a 25-ton, 54-inch stroke unit, tooled for broaching the $1\frac{1}{2}$-inch ID of two 5 9/16-inch long steel sleeves, two at a time. **American Broach & Machine Co.**, Ann Arbor, Mich.

Circle 428 on Inquiry Card

Arc Power Supplier

Used as the power source in semiautomatic and automatic welding processes, including inert gas, submerged arc and metallic arc, constant voltage welding machines feature simplified operation and instantaneous arc starting and recovery. When used with the controlled speed wire feeding device, the power source provides instant, automatic compensation for tack welds, poor fit-up, and other irregularities, and also provides finished welds of uniform appearance and properties under a wide range of operating conditions.



Machines are used in conjunction with a wire feed mechanism which feeds the electrode at a constant rate. For maximum utility on a wide range of applications, the rate of feed is adjustable. The operator sets the correct rod feed and travel rate to produce the desired rate of deposit for the electrode employed. In operation, the wire is melted off at a rate equal to the feed rate. The faster the electrode is fed into the arc, the more current is required to burn it off. The heat and resultant rate of melting are therefore regulated by the rate of feed. Arc length is regulated by raising or lowering the impressed voltage on the circuit.

Units are used in submerged arc welding in pipe mills, pressure vessel and tank fabricating shops and on structural and general shop and field applications. In inert gas welding, the machines are used on aluminum, copper, and steel. **M & T Welding Products Corp.**, 703 37th Ave., Oakland, Calif.

Circle 429 on Inquiry Card

NEW

Modernair
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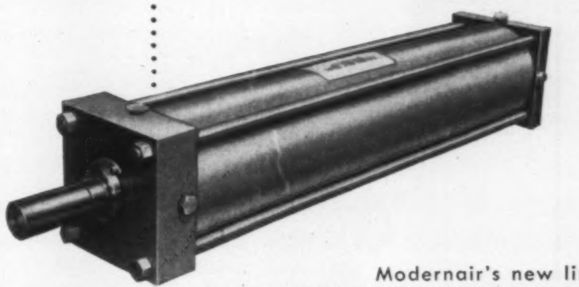
HEAVY DUTY CYLINDERS



Modernair's new line of heavy-duty cylinders has been developed to meet the need for a rugged, reliable, long-lived cylinder under heavy mill-type service conditions.

They are offered in two types: the series HA for air service up to 200 psi; the series HH for hydraulic service up to 1000 psi. Both types are available in 3¼", 4", 5" and 6" bore sizes, stroke length optional.

CONSTRUCTION FEATURES

Rolled steel cylinder heads

Extra-heavy tie rod construction

Heat-treated, chrome-plated piston rod resists wear and corrosion

Self-adjusting, wear-compensating "Uneepac" seals on rod packing

Cartridge-type rod packing and gland seal assembly for easy servicing

High tensile aluminum alloy piston head, specially treated for corrosion and wear resistance

Needle-valve cushion adjustment—floating high durometer Hycar "O" ring type cushions on HA cylinders, tapered cushion bosses on HH cylinders

Modernair "ruggedized" cylinders and control valves can cut your maintenance expenses and downtime losses to the bone. Why not get the facts **now?** Write for catalog, specifications and prices... please address Dept. C-1.

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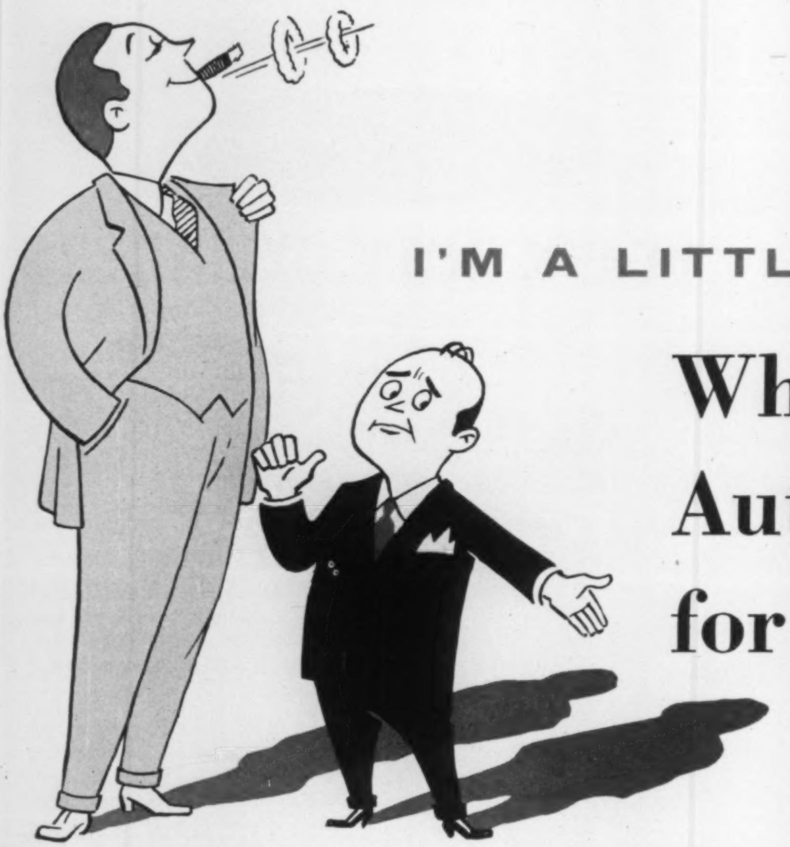

I'M A LITTLE GUY—

What's in Automation for me?

Depends on what you mean by automation. If you think of automation as a "push-button controlled automatic factory" the cost is probably beyond the means of the "small" manufacturer.

But if you think of it in terms of getting the most production at the least cost from the machines you have—then:

Your Bellows Field Engineer can show you ways by which, for a small investment in time and money, you can convert many of your present machines into high producing semiautomatic or automatic machines.

It doesn't matter what you make—how big or small your operation—you'll find Bellows "Controlled-Air-Power" Devices will pay for themselves quickly—often before the due date of the invoice we'll send you.

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MANUFACTURERS OF AIR POWERED WORK UNITS: AIR MOTORS, AIR CYLINDERS, AIR HYDRAULIC CONTROLS, WORK AND TOOL FEEDING AND HOLDING DEVICES. FIELD ENGINEER OFFICES IN ALL PRINCIPAL CITIES AND INDUSTRIAL AREAS IN THE UNITED STATES AND CANADA.

AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems

For detailed information and literature, use card page 17

Variable Speed Drive

Developed to meet future needs for increased automation, regulated electronic speed drive is designed for inclusion in automatic systems. Available in capacities from 30 to 150 hp, the unit consists of an operator's control station, electronic control unit and a dc motor. The electronic control is comprised of an ignitron controlled three-phase, full wave rectifier system with its associated firing circuits, variable field supply, feedback tachometer, protection and switchgear circuits. Dynamic braking, reversing, forward-reverse-jog operation, tachometer feedback, acceleration and armature current limiting are included as standard features.

With the exception of the dc motor, all components are static and have no inertial properties to slow down system response. Ignitrons, thyratrons and magnetic amplifiers provide full field starting, smooth acceleration and infinitely variable speed over a range of at least 32 to 1, 8 to 1 armature control and 4 to 1 field control, with a regulation of 1½ per cent or better. Circuit features include fail-safe protection, automatic current limiting, armature voltage limiting, automatic ignitron current balancing and automatic compensation for line voltage fluctuations up to ±10 per cent.

A low-power dc voltage is all that is required to control motor speed. The control voltage is available as a function of the speed setting on the operator's control station, or one or more external voltages may be used which are derived from various transducers integrated in a machine or process. **Raytheon Mfg. Co., Commercial Equipment Div.,** 100 River St., Waltham 54, Mass.

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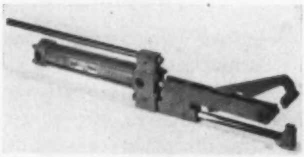

Unloader Jaw Assembly

Designed to fit conventional air powered straight line or swinging arm type press unloaders, vertical flange jaw assembly unloads stampings having vertical flanges at the point of pickup. The air cylinder that opens and closes the jaw is a specially designed heavy-duty type having a bronze piston head, a floating bronze cushion, cartridge type rod packings. chrome plated full-diameter piston rod, U-type piston packings and O-ring cylinder seals. Nylon or neoprene jaw inserts, instead of standard hardened steel buttons, are available.

The assembly is made in two models, each having 1¼-inch jaw openings. Model 715 has a 7-inch stroke and a 1½-inch diameter cylinder; Model 820 has an 8-inch stroke and a 2-inch diameter cylinder. Larger strokes are available on special order. **Press Automation Systems Inc.,** 18616 Wyoming Ave., Detroit 21, Mich.

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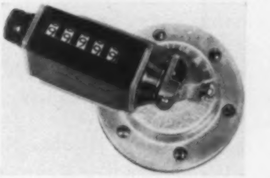

Automatic Counter

Used for any operation controlled by pneumatic or hydraulic action, line of accurate automatic counting devices features a rapid installation time of only 5 minutes. The counters screw into the line controlling any air or hydraulic cylinder. Units have no linkage to assemble or get out of adjustment, and no solenoid, eliminating the possibility of half or miscounts. Models are available for from 5 to 5000 psi and up to 300 counts per minute. All counters are available with five or six digits and knob or key reset. Illustrated model SEP is for operation from 5 to 150 psi and has clockwise rotation of numbers; four other models are provided in this line. **Pneumaticount,** 3400 N.E. 54th Ave., Portland, Oreg.

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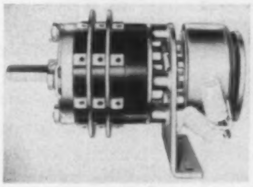


Rotary Switches

Designed to provide automatic, remote control of electrical circuits, heavy-duty, rotary multipole switches are assembled with solenoid rotating devices that drive the switch through the cycle of contact positions. The indexing stroke of the solenoid device is matched to the degree of rotation between contact positions of the switch, and drives the rotor one position each time the solenoid circuit is closed. This circuit may be closed by pushbutton or by simple mechanical motion of the governed machine, providing the control needed for automation.

The electrical load and environmental conditions determine the rotary switch and solenoid rotating device that must be used. Standard and special assemblies of rotary multipole switches with solenoid actuating devices are supplied to meet requirements for rotary switch use. **Electro Switch Corp.,** Weymouth 88, Mass.

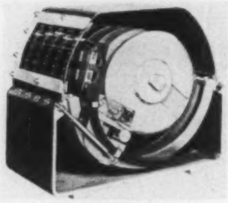
Circle 433 on Inquiry Card

Power Controls

Developed for automatic or manual control of power to a load, units in line of saturable reactors are well suited for stepless control of electrically heated equipment, reduced voltage in ac motor starting cicuits, and loading reactors for test boards.

By changing the magnetic characteristics of the reactor core, the impedance can be varied by means of a dc control winding, thus enabling the reactor to provide a wide range of stepless control in the ac power circuit, with smooth and even adjustment over the entire range. It also provides a small voltage drop in the reactor at full saturation and permits 90 per cent of the line voltage to be applied to the load. The reactors are provided in an enclosed case with removable panels for installation and wiring, or open for mounting in a control panel. Output capacities range from 0.3 to 500 kva. **Hevi-Duty Electric Co.,** Milwaukee 1, Wis.

Circle 434 on Inquiry Card



Cam Limit Switch

Designed to facilitate precise synchronization of multiple operations, rotating cam limit switch with 15-amp contacts features a positive micrometer screw adjustment of each individual switch mechanism in relation to its cam. The adjustment can be made with a screwdriver from the outside, while the switch is in motion. Type AL cam limit switch is made in three standard sizes accommodating up to five, nine or 12 cams. The split butterfly cams can be set with a spread between circuit make and break of from 15 to 345 degrees, and the external in-motion adjustment of ±15 degrees makes possible microadjustment while equipment is in motion.

Contact assemblies may have two sets of contacts, one normally closed and the other convertible—either normally open or normally closed. Contact operating arms bearing on the cams have nylon rollers which lessen wear. The switch is designed to operate at speeds up to 100 rpm, and rotation can be either clockwise or counterclockwise. **Clark Controller Co.,** 1146 E. 152nd St., Cleveland 10, O.

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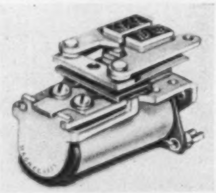

Telephone Type Relay

Reliable switching of heavy current in limited space is a feature of Class 22D telephone type relay. Specially designed double-break contacts on the device switch up to 20 amp, noninductive load. Contacts are single-pole, single-throw, normally open. Overall dimensions are 1 1/16 inches wide by 1 9/16 inches high by 2 1/16 inches long. Relay is available for operating voltages to 230 dc and 440v, 60 cycle ac. **Magnecraft Electric Co.,** 3354D W. Grand Ave., Chicago 51, Ill.

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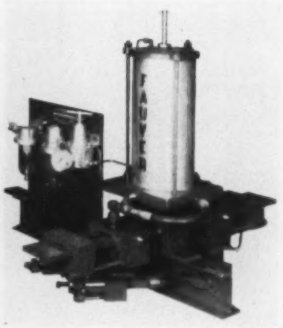


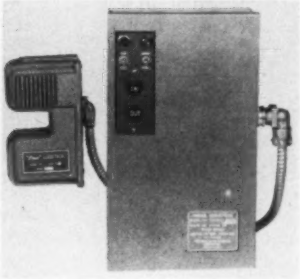
Conveyor Lubricators

Consisting of two types, Model 702 which lubricates only one side of a monorail conveyor, and Model 704 which lubricates both sides of a monorail conveyor, 700 series of conveyor lubricators feature improved design. Among changes in the series are an improved air control panel, filter, regulator and lubricator; universal pick-up; and elimination of all drippage by the use of a nozzle with automatic shut-off feature. **J. N. Fauver Co. Inc.,** 51 W. Hancock Ave., Detroit 1, Mich.

Circle 437 on Inquiry Card

Edge Guidance Unit

Used for accurate printing, coating, tubing and rerolling, slitting and punching, tentering, intersheeting and manifolding, Linear Edgetrol photoelectronic edge guidance system controls edge registration and web position of all opaque materials; porous materials such as lace, gauze, screening, netting and nonwoven fabrics; single thickness films such as polyethylene, vinyl and cellophane; and laminates. Completely self-contained, the equipment is fully automatic. Seven sensing heads provide a variety of models, enabling complete system operation with any material under



any conditions. Since edge detection is by photoelectric means, no force or pressure is applied to the material under control, solving the problem of errors which might occur due to side motion of light or loose material.

Capable of maintaining control accuracies within 1/32-inch at any speed, the systems are available in three integrated forms for use with present web control equipment as well as in new applications where edge control has previously been impossible. **Intercontinental Dynamics Corp.,** 170 Coolidge Ave., Englewood, N. J.

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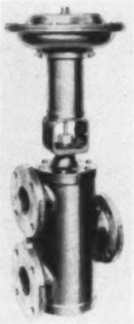

By-Pass Valves

Designed for the accurate control of liquid flow, line of three-way by-pass valves simplifies maintenance. Valves feature a construction which makes it possible to change the disks and seat rings without removing the entire valve from the pipe line. Slamming and water hammer noise is eliminated by seating both disks against the flow.

Total capacity of the valves is constant, regardless of the position of the inner valve. Flow can be directed to either of two outlets as required. The by-pass valves are designed to be completely tight closing, making them well suited for diverting applications which ordinarily require the use of two separate valves. The units, with molded rubber diaphragm operators, are available in $2\frac{1}{2}$, 3 and 4-inch sizes. Maximum pressures range up to 250 psi at 406F and 400 psi at 70F. Maximum control air pressure is 25 psi, and the valves are furnished for either proportional or two-position control. **Johnson Service Co.,** Milwaukee 1, Wis.

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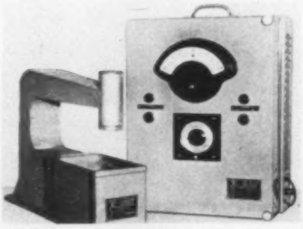
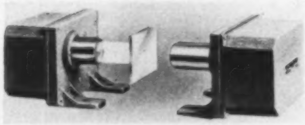


Portable Noncontact Gage

Designed to measure the thickness of material in process, such as plastic sheet and tube, rockwool bats, wall board, plate glass, rubber sheet, cracker dough sheet, paper, cotton batting, felt, etc., portable electronic noncontact device is called the Xact Ray Gauge. Accuracy is to within 1 per cent of a predetermined standard. The gage employs an x-ray beam whose energy is transmitted through the material being measured. **Industrial Gauges,** W. Englewood, N. J.

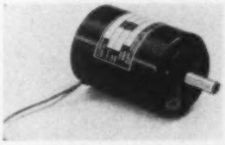
Circle 440 on Inquiry Card



Photoelectric Control

Designed for operation by glass, cellulose and various transparent materials, photoelectric control unit produces a light beam of short wave length which glass, cellophane, etc. interrupts. The unit is actuated by a special light beam at distances up to 5 ft. Minimum phototube light time and phototube dark time are 0.05-second each. A control relay energizes when light is on the phototube. Contacts are double-pole, double-throw, rated 8 amp at 115v ac, noninductive, 50 to 60 cycles. **Autotron Co.,** Box 722-RR, Danville, Ill.

Circle 441 on Inquiry Card



400 Cycle AC Motors

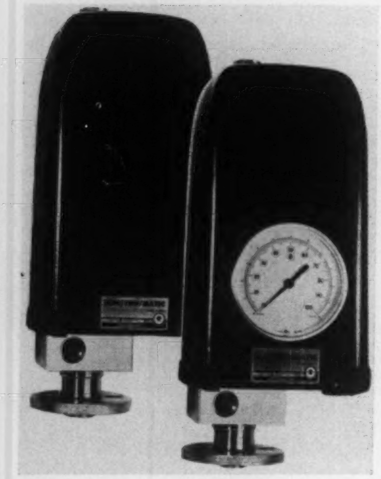
Available with induction or hysteresis rotors, 400 cycle ac motors are designated Type FC. The weight of the motor is 11.5 oz. The induction rotor provides a unit with more output than a unit with a hysteresis rotor, but the hysteresis unit operates at synchronous speeds. Motors can be wound three-phase, two or four-pole; or two-phase, two or six-pole. Both three and two-phase units can be operated single-phase with a suitable phasing capacitor. Overload protection can be supplied.

The characteristics of the motors can be modified to cover a wide range of application requirements. Characteristics such as starting torque or improved starting at low temperatures can be individually controlled by compromising other factors. The motors can also be furnished with integral planetary gear reducers. **Globe Industries Inc.,** 1784 Stanley Ave, Dayton 4, O.

Circle 442 on Inquiry Card

Flow Transmitters

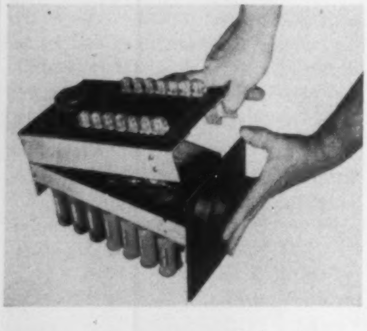
Interchangeable pneumatic and electric transmitters which are designed for use with Brooks rotameters feature standardization for the field of remote flow transmission. Called the Transi-Twins, the units are the Mag/Nu/Matic pneumatic transmitter and the Elec/Tru/Matic electrical transmitter. Both transmitters have the same rotameter extension unit and the same interchangeable armature unit. The pneumatic and electrical transmitter units are different



from each other, but can be readily interchanged by means of three screws.

The pneumatic transmitter employs direct force balance to minimize mechanical motion, thus providing low inertia characteristics and improved response time. The electric transmitter utilizes a strain gage element. Standard models are explosion-proof and can be used with any receiving instrument. Transmitters are applicable to automatic logging and data reduction equipment. **Brooks Rotameter Co.,** Lansdale, Pa.

Circle 443 on Inquiry Card

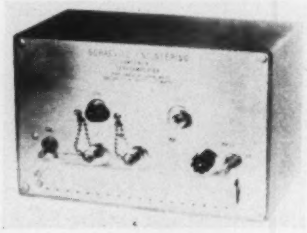


Packaged Controls

Available for fully automatic control of many types of machine tools and manufacturing processes, packaged controls are designed to meet the demand for controls that can be installed or adapted within limited space. Called Directors, the controls direct machines to perform various sequences of simultaneous functions to form complete cycles of operation. Company devices can be employed in connection with the controls to continually check on the performance of the functions; if the performance is not correct, the Director either stops the operation or corrects it.

Units are built in hinged multideck form to make all connections and components available for inspection and service. The controls are furnished as completely wired plug-in packages with wiring harnesses and terminals ready for connection to the machine motor controls and switches. Size of illustrated unit is 6 by 7 by 11 inches. **Sensory Inc.,** 506 Pleasantville Rd., New Vernon, N.J.

Circle 444 on Inquiry Card

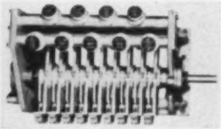


Servoamplifier

Designed to power the control winding of a small, two-phase motor in a linear voltage differential transformer controlled servosystem, high gain servoamplifier is called Model SA60C-4. Unit is used for applications in which the amplification of 60 or 400 cps signals is required to produce up to 4w of controllable power to actuate relays, power small motor windings or for any suitable load insenitive to phase inversion.

When operated in response to the displacement of the core of a linear variable differential transformer, a wide variety of applications is possible. Measurements include force, weight and stress, linear displacement, pressure, liquid flow, level, torque and surface contour. The primary actuating signal is a variable carrier voltage which is produced by the differential transformer. An in-phase output voltage will continue to be produced when the input voltage is increased many times beyond the minimum value required to produce full output. Line power is 105 to 130v, 60 or 400 cps. **Schaevitz Engineering,** P.O. Box 505, Camden 1, N. J.

Circle 445 on Inquiry Card



Press Limit Switch

Designed for timing of material handling and other auxiliary functions necessary for automatic press operation, limit switch is a rotary cam type unit. The increased use of iron hands, stock unloaders, die lifters, dopers and other automatically controlled devices in conjunction with Clearing presses created the need for a timing and controlling mechanism which could be set with high accuracy. With the limit switch, fine timing is possible while the equipment is in operation; hairline adjustments can be made through a full 30 degrees of cycle.

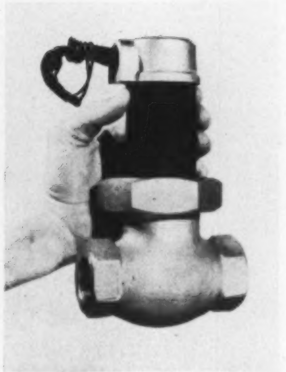
The switch is furnished in three sizes: Four, nine and 11-cam units. The 11-cam switches are recommended for double and triple-action presses. Nine-cam switches are required for straight side single-action presses.

Control of automatic devices is accomplished in three ways. (1) Timing relays are used in conjunction with the limit switch to hold a circuit closed for a set period of time. With this method, one of the cams on the switch is used to energize a circuit and a timing relay will break the circuit when the set time has elapsed. (2) With two cams, they can be adjusted so that one cam will complete a circuit and the other will break it. This action is set for a prescribed number of degrees of cycle. (3) A single cam may be used to initiate the operation of a device where the device is stopped or returned by an external limit switch on the device itself. **Clearing Machine Corp., Div., U. S. Industries Inc.,** 6499 W. 65th St., Chicago 38, Ill.

Circle 446 on Inquiry Card

Solenoid Valve

Designed to operate at pressures ranging from 10 to 3000 psi, 1-inch stainless steel valve is two-way globe type, pilot operated with packless construction. Standard model is normally closed, but with



modification, it can be made normally open through 300 psi; with the use of a relay, it operates to 3000 psi. With a relay, power must be supplied at all times, since the valve will not open on power failure. Two variations of the basic valve are available: Type SS, with a standard coil for operation to 300 psi, and Type HPSS with a high pull coil for applications to 1500 psi. Over 1500 psi and to 3000 psi, a double-wound coil and relay are required. Function of the relay is to energize a primary winding, giving a strong impulse to positively open the pilot valve. Secondary winding is then cut in, holding the valve open at low current consumption. Features of the new valve include high corrosive resistance, since all parts coming in contact with the medium are 316 stainless steel, except for the magnetic armature which must be of 416 stainless steel. In addition, the valve features unbreakable piston rings to assure stick-free operation; glass wound silicone impregnated coils for operation at elevated temperatures; optional explosion proof housing for hazardous locations; and simple construction, for long trouble-free life under extreme conditions. **Atkomatic Valve Co. Inc.,** 545 W. Abbott St., Indianapolis, Ind.

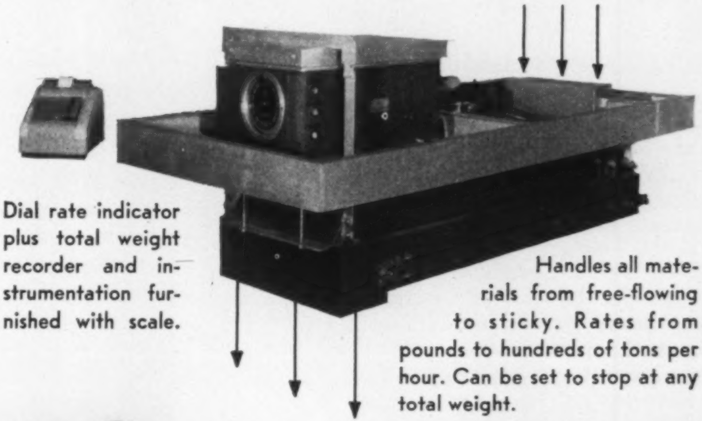
Circle 447 on Inquiry Card

Multiple Drive System

Developed for use with the Varidyne multiple drive system, illustrated compact power unit is designed with the drive motor and alternator on the same side. The unit provides variable frequency power to the Varidyne motors in the system, thus electrically link-

NEW Thayer BELT FEEDER
CONTINUOUS WEIGHING

Only Thayer Scales have the Thayer Plate Leverage System that is guaranteed accurate for the life of the scale.



Dial rate indicator plus total weight recorder and instrumentation furnished with scale.

Handles all materials from free-flowing to sticky. Rates from pounds to hundreds of tons per hour. Can be set to stop at any total weight.

THE Thayer SCALE

BATCHING • FILLING • CHECKING — AUTOMATICALLY BY WEIGHT

AUTOWEIGHTION

THAYER SCALE and ENGINEERING CORP., ROCKLAND, MASS.

Circle 585 on Inquiry Card

HIGH-RATE HOPPERING WITH
NO TUMBLING DAMAGE

KDI's
Unique
Centrifeed
Hopper

Unique horizontal manganese bronze rotor eliminates tumbling damage to parts . . . gentle enough to hopper glass bottles. Ideal for brittle, hardened bearing races.

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KDI CORPORATION

FORMERLY KRAUS DESIGN, INC.

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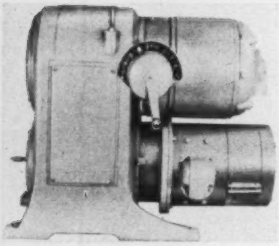
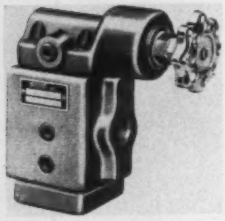
SPECIALISTS IN MECHANICAL HOPPERING, AUTOMATIC ASSEMBLY MACHINES, AND INTEGRATED PARTS PRODUCTION LINES

Circle 586 on Inquiry Card



ing them together. The system has converted standard 60-cycle, three-phase, ac squirrel cage motors into variable speed motors. The alternator, driven at variable speeds, generates a frequency proportionate to its speed and transmits this variable frequency to each of the Varidyne motors in the system. By changing speeds at the power unit by means of a handwheel, speed of each motor in the system varies equally and simultaneously. The system is ideal for co-ordinating machinery, conveyors and other multiple drive operations. When motors are operating in tandem, as on a conveyor, motors equally share the load. **U. S. Electrical Motors Inc.,** Box 2058 Terminal Annex, Los Angeles 54, Calif.

Circle 448 on Inquiry Card

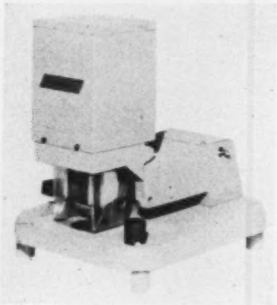


Reducing Valves

Used for industrial oil-hydraulic systems, two low-pressure type pressure reducing valves feature a broad pressure adjustment range, being capable of providing any controlled reduced outlet pressure from 25 to 1000 psi. The pressure reducing valves are used to provide controlled maximum operating pressure for secondary circuits. Such pressure reduction is required to prevent possible damage to machinery or to a part being produced.

Both valves are for use with ⅜-inch nominal pipe size in systems having operating pressures up to 2000 psi. Model XGL-03-B is a gasket mounted design; Model XTL-03-B is provided with ⅜-inch pipe thread connections. Both units are nominally rated at 8 gpm flow capacity. Free reverse flow is allowable, provided pressure at the reduced pressure port does not exceed the reduced pressure setting of the valve. **Vickers Inc.,** Box 302, Detroit 32, Mich.

Circle 449 on Inquiry Card

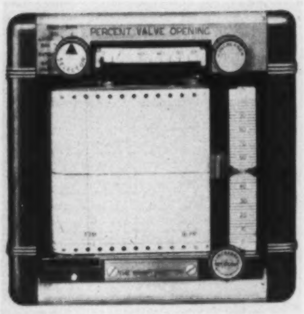


Automatic Imprinters

Electric numbering, dating, and coding are done automatically by machine called the Powermark. The machine is designed to imprint numbers, dates and codes through carbon sets, as Azograph or spirit carbons, or single sheets. Eight to 12 copies with carbon inserts can be accommodated. Features of the Powermark include: Electric power printing, electric power inking, and electric power drive for automatic consecutive number change. Operation is not dependent upon springs or unpredictable forces. Turret heads, visibly adjusted magnetic guides and remote triggering are available to provide efficiency in operation. **Force Western Inc.,** 216 W. Jackson Blvd., Chicago 6, Ill.

Circle 450 on Inquiry Card

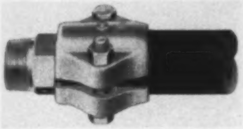
Unitized Controller



Based on the principle of instantaneous all-electronic control, line of controls has been unitized. Controller, recorder or indicator, and manual control are of plug-in construction. Any combination of units is contained within a universal mounting case requiring a single standard panel cutout of only 5 by 5 inches. Instruments can be pulled out of the panel for calibration, test or maintenance without employing jumpers and without upsetting system balance.

Since units are of the plug-in type, two or more functions can be combined in a universal mounting case. Thus, a typical unit might consist of a single case enclosing a recorder. To this can be added a manual control which is visible through the same panel cutout. A controller can then be plugged into the back of the mounting case. Controls incorporate printed circuits, miniature tubes and ruggedization of components. **Swartwout Co.,** 18511 Euclid Ave., Cleveland 12, O.

Circle 451 on Inquiry Card



Clamp Type Hose End

Designed to provide versatility in high pressure lines for air, hydraulic fluids and steam, clamp type hose end couples readily on other types of hose. The hose end requires no hose skiving or special tools.

Applications for the device are in hydraulic machinery used in construction, farming, materials handling, transportation, excavating, drilling, mining, and manufacturing; in air lines used on compressors, drills, hammers, tampers, vibrators; in steam lines on equipment in chemical industries, food processing, cleaning and manufacturing. Hose ends are available in ¼, ⅜, ½, ¾, 1, 1¼, 1½, and 2-inch sizes. **Weatherhead Co., Fort Wayne Div.,** Fort Wayne, Ind.

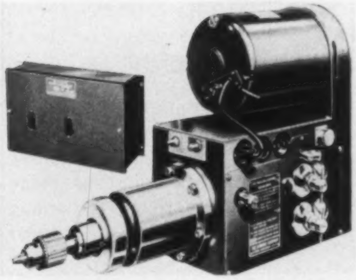
Circle 452 on Inquiry Card

Digital Ohmmeter

Precise automatic measurements of a wide range of resistance values are provided by Model 751 digital ohmmeter. Designed especially for industrial applications where sturdy construction and the benefits of volume production economies are of importance, the ohmmeter has oil-sealed stepping switches for trouble-free life. Resistance values are displayed by four in-line luminous numerals 1-inch high, with automatically shifting decimal point and automatically varied resistance symbols. Permanent records can be made by connection of accessory digital recording systems.

Range of the instrument is from zero to 9.999 megohms with minimum resolution of 10 ohms. Sampling rate is 60 cps; response is 1 second (average); and accuracy is ±0.1 per cent of measured resistance or 1 digit, whichever is greater. **Non-Linear Systems Inc.**, Del Mar Airport, Del Mar, Calif.

Circle 453 on Inquiry Card



Driller and Tapper

Choice of production drilling or tapping by a flip of a switch is possible with drill and tap unit

EAGLE

time delay relay

for transmitters and other industrial
or aircraft applications

Compactness . . . plus **"Mil-Spec"** precision

A complete timer, weighs only 9 ounces. Yet it passes rigid military tests for accuracy, vibration, shock, salt spray, humidity. Developed for radio and radar transmitters, now available for any application that requires this precision, space-saving timer.

As one example, this new timer (HYS series) gets electronic equipment back into service just as quickly as warm tubes reheat to safe operating temperatures. Starts operation *minutes sooner* when tubes have not completely cooled from a previous operation. It's safe. Cuts lost operating time. Standard 28V D. C. Other D. C. ranges on request. Units may be operated from 115V A. C. rectified source. Free bulletin.

EAGLE TIMERS SAVE TIME • SAVE MONEY

EAGLE
SIGNAL CORPORATION
Industrial Timers Division
MOLINE, ILLINOIS

------*MAIL COUPON TODAY*-------

Eagle Signal Corporation, Dept. A-157
Industrial Timers Division
Moline, Illinois

Please send Bulletin 820 with operation data and specifications on the new HYS series time delay relay.

NAME AND TITLE

COMPANY

ADDRESS

CITY ZONE STATE

Circle 587 on Inquiry Card

If it's hard to hold...

call Garrison

The harder the holding problem . . . the better we like it!

We specialize in custom-made holding fixtures.

We designed and built the first automated gear chucks in the world . . . all are still in use . . . reorders have been many . . . millions of gears have been made on these automation chucks.

Call us the moment the matter of automation arises, because the part to be processed must be located properly before the machine can do the work.

To automate or not to automate — that is the question

If you are in Standardation* and not ready for the plunge into automation . . . we can design special holding fixtures for your standard machines that will help match the efficiency and production capacities of automated equipment!

If you are already in automation (the process is not new to us) . . . we are prepared to build special holding fixtures for your automated equipment.

Interested?

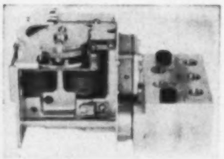
*Our own word for Standard Practices.

GARRISON MACHINE WORKS, INC.
DAYTON 4, OHIO, U.S.A.

known as Series 28 Drill-N-Tap. Instant changeover from drilling to tapping for long or short production runs is possible without adding a special tapping attachment. Both drill and tap insert directly into the standard ⅜-inch capacity chuck. Direct tool approach results in less tool overhang, closer mounting to the work fixture and the use of the same fixture to drill and tap for lower tooling costs.

With the control set for tapping, the direction of rotation automatically reverses at bottom of stroke to withdraw tap. Two-way pneumatic system which makes it possible to infinitely adjust both the forward and retract air pressures, prevents tearing of top threads when pulling the tap out of the workpiece. In addition to providing mass production savings on an automatic basis for long production runs, the unit's versatility and adaptability offer a practical solution to shops with short, constantly changing production. Complete interchangeability is possible where several units are being used as basic heads for rotation on a number of different setups. Packaged Drill-N-Tap unit has electrical and pneumatic controls built in. Complete fixture press with rectangular or round table to replace hand operated drilling operations is also available. **Dumore Co.,** Racine, Wis.

Circle 454 on Inquiry Card



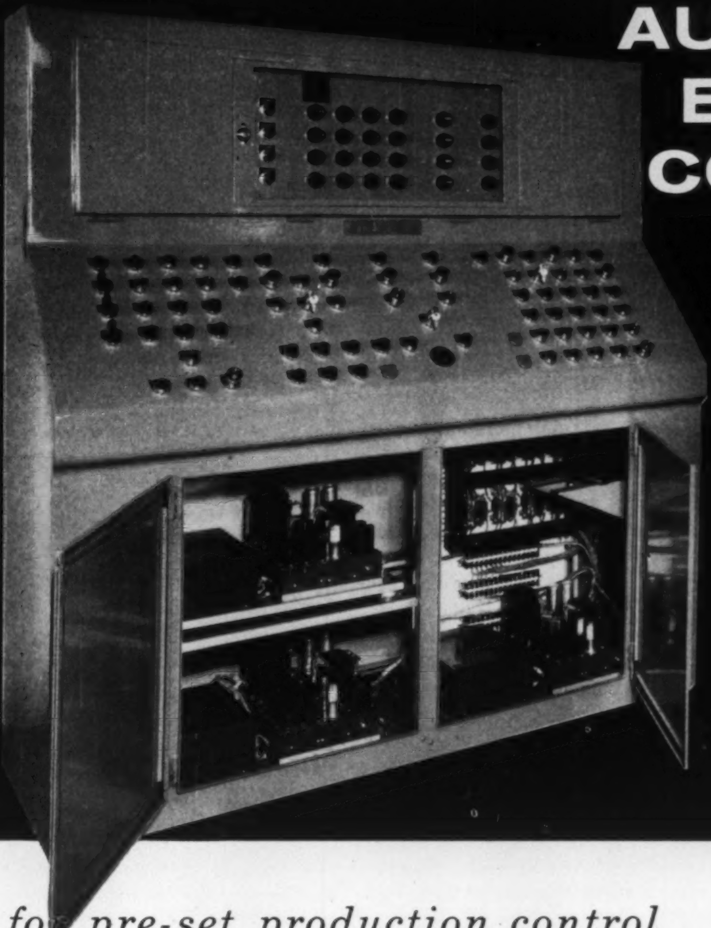
Computing Relay

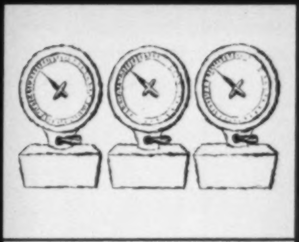
Used for fuel-air flow ratioing, boiler swell compensation, and flow totalizing on multiple lines, Model 56-1 pneumatic computing relay can be adjusted to perform any one of six different arithmetic functions. Measurements are received by the relay as pneumatic signals (3-15 psi); computer output to a recorder or controller is also in terms of 3-15 psi.

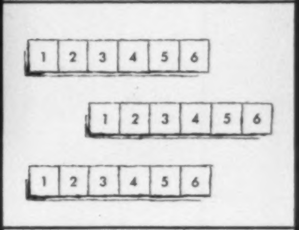
Consisting of a modified Model 58 Consotrol controller with new type manifold, the relay operates

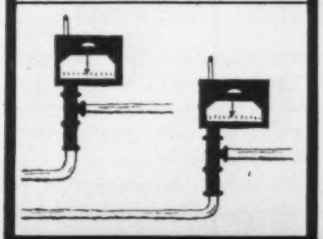
Circle 588 on Inquiry Card

AUTOMATIC BATCHING CONTROLS









fo pre-set production control

This Gemco custom batching control, one of many for the aggregate and ready-mix concrete industry, typifies the control possible on a variety of batching problems.

It enables pre-setting of four batching formulas, with weight limits accurate to 1 in 5000 and each cycle started by a push-button. Digital registers enable pre-setting for various types of aggregate, for water content, and for cement content. Signal amplifiers for the weight pick-ups can be either conventional or Gemco magnetic amplifiers. Such Gemco techniques offer opportunity also for batch type production of small parts on one or many machines in unison or sequence, in plastics, in food processing — anywhere that intermittent or variable products call for discrete quantities in terms of weight, dimension, volume, count, etc.

GEMCO
CUSTOM CONTROLS

WHAT'S YOUR CONTROL PROBLEM?

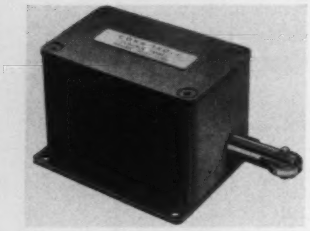
Gemco designs and builds special controls and systems for all industries, including automatic machining, materials handling, parts testing. For specialized control needs, bring your problems to the control specialists.

GEMCO ELECTRIC COMPANY • 25681 W. EIGHT MILE RD. • DETROIT 19, MICH.

Circle 589 on Inquiry Card

on the force balance principle, with four bellows positioning a floating disk about a fulcrum. The disk acts as the flapper of a conventional flapper - nozzle detector. Forces exerted by pressures in the bellows establish the position of the disk in relation to the nozzle. The resulting pressure change in the feedback bellows maintains the balance position of the disk. The manifold provides external connections to all four bellows so that measurement signals can be received and computed according to the equation desired. The adjustable fulcrum is used to weight the various measurements according to their values in the equation. Substitution of springs for certain bellows will change the relay from one computing function to another. **Foxboro Co.,** Foxboro, Mass.

Circle 455 on Inquiry Card

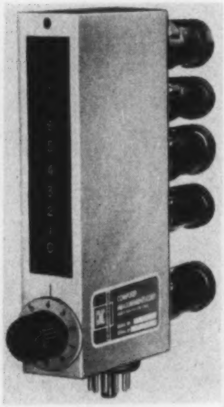


Position Transducer

Designed especially for machine tool applications in which it must be sealed against the entrance of oil, water and dirt, transducer features sealed lubrication of the moving parts with no danger of contamination of the resistor element. The unit is designed for use where a signal must be taken from the position of a slide or cam, and this signal used to control the position of another machine part or the speed of some drive or feed motion.

An example of the transducer in application is in a constant cutting speed drive where the speed in rpm of the work is dependent upon the position of the cutting tool or upon the diameter at which the tool is cutting. The cam roll may be turned 90 degrees from the position shown in the illustration. Wiring is fed through a ½-inch standard conduit connection. **Conn-Trols,** Pleasant Valley, Conn.

Circle 456 on Inquiry Card

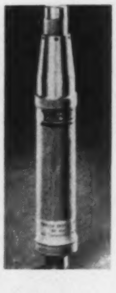


Decade Counter

Used for batching, sorting, packaging, automatic counting and control, frequency division, generation of precise delays, etc., Model 101A decade counter is designed to provide an output pulse at a selected number, at rates in excess of 40,000 counts per second. If reset is not required, they are capable of counting at a 100,000 cps rate. Units are easily connected in cascade in order to emit a pulse at any desired count.

Input requirement is negative pulse, 75 to 100v peak; rise time is 1 microsecond maximum. Input impedance is 100 micromicrofarads in series with 16,000 ohms. Reset to zero is instantaneous by opening the grid circuit or by application of 70v pulse at least 15 microseconds wide. **Computer-Measurements Corp.,** 5528 Vineland Ave., N. Hollywood, Calif.

Circle 457 on Inquiry Card

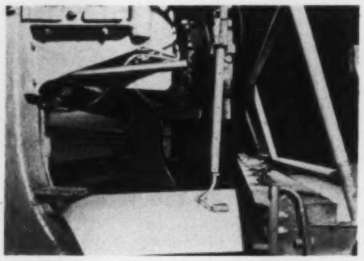


Liquid Spring

Designed to accelerate and decelerate a mass, liquid spring model S 1064-6 uses liquid compressibility. Device includes a high velocity liquid spring for use where high energy is required instantaneously. With the ¾-inch stroke, 90 per cent is a spring and 10 per cent acts as a shock absorber to stop the high velocity piston without structural damage. High velocity output can be used to accelerate a mass and high impact cushioning action can be used to decelerate a mass without impact loading.

Spring develops 6400 lb spring action with a preload of 1000 lb and provides 10 inch-lb of shock absorption while at the same time providing 200 inch-lb of high velocity energy output with a total efficiency of 77 per cent. **Taylor Devices Inc.,** 188 Main St., N. Tonawanda, N. Y.

Circle 458 on Inquiry Card



Moisture Gaging Device

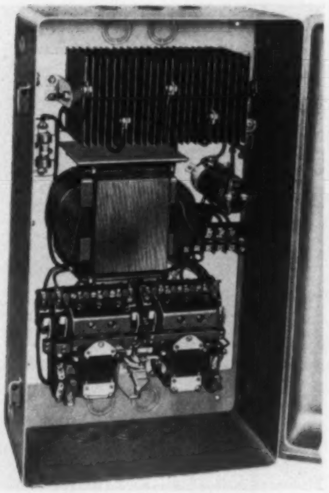
Developed to determine paper moisture, gage measuring system is called the Aquatel. The device uses electrical conductivity of paper when an ac voltage is applied to it. The resultant signal is fed into a bridge circuit in which the capacity of the sample and the measuring system are cancelled out. An attenuator section allows compensation for temperature, various types of finishes and basis weight variations.

The principle of measuring ac conductivity and the design of the measuring elements result in an insensitivity to both the contact pressure and the presence of static electricity. Range of operation is 3 to 10 per cent moisture content with an operating accuracy of ±0.25 per cent obtainable.

The AQL laboratory model is used for individual sample measurements. The sample is placed on the measuring electrodes and the per cent of moisture content is read directly on a meter. The AQM scanning unit is designed to scan the entire web of the paper machine at a speed of 10 fpm, presenting both the integrated average of the sheet moisture content and the moisture profile. The integrated average of the scanning cycle is utilized for automatic control.

A feature of the Aquatel is the servopositioning of the sensing head, which automatically compensates for changes in the pass line. On a sheet break the measuring head automatically moves to a retracted position off the edge on the back side of the machine. When the sheet is in place the gage returns to operation, automatically contacting the sheet. **Isotope Products Inc.,** 1711A Elwood Ave., Buffalo, N. Y.

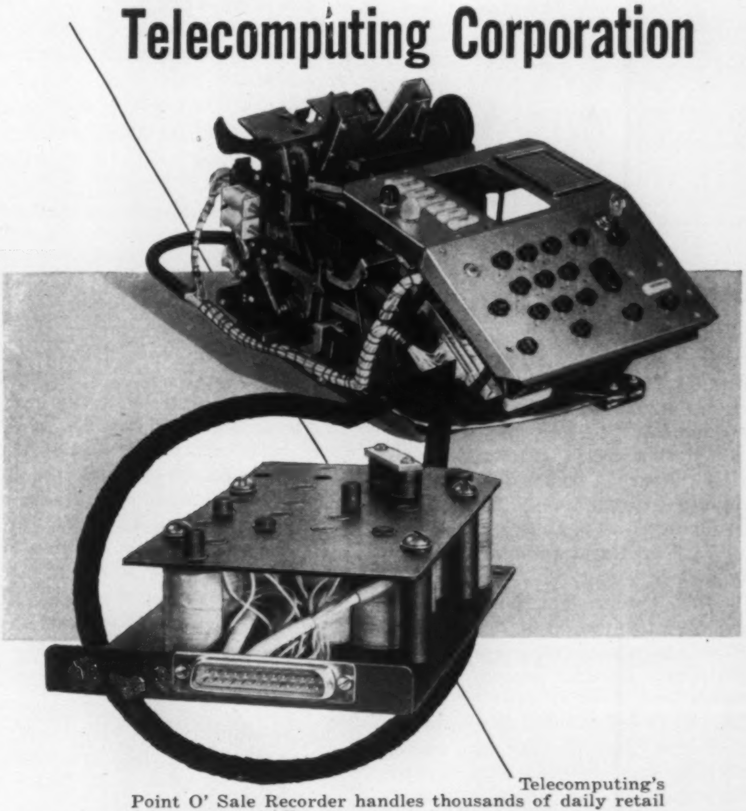
Circle 459 on Inquiry Card



Packaged Controller

Positive electrical braking for standard ac motors is provided by packaged controller. Through electrical braking, braking torque diminishes as the motor decelerates until a smooth, definite stop results, normally in the same time required for acceleration of the driven equipment. Controls can be installed directly to the motor.

To accomplish braking, direct current from a selenium rectifier is applied to one phase of any squirrel-cage or wound rotor motor. A timing circuit allows direct current to flow only enough to stop the motor. When activated from any desired pilot control, braking begins immediately after the stop



WesCo miniature solenoids solve control problem for Telecomputing Corporation

Telecomputing's Point O' Sale Recorder handles thousands of daily retail sales automatically.

The recording operation starts at the input keyboard. Each of the eighteen keys actuates a miniature solenoid. Telecomputing engineers required solenoids which would do a big job in small space, which would be reliable, fast, accurate. They solved this problem with WesCo miniature solenoids.

Together, WesCo and Telecomputing engineers packaged the eighteen small solenoids, wiring and connectors into a module. This package fits under the keyboard of the Point O' Sale Recorder.

If you too, need a solenoid for maximum work in small space, WesCo has many miniature, sub-miniature, single or multiple solenoid designs for you.

THE TRADEMARK ON MILLIONS OF SOLENOIDS SINCE 1927

WesCo WEST COAST ELECTRICAL MFG. CORP.

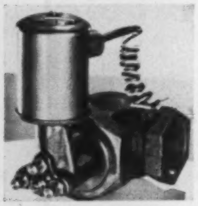
233 West 116th Place • Division 122 • Los Angeles 61 • PLymouth 5-1138

Circle 590 on Inquiry Card

signal is received; reduced capacity taps on a transformer permit selection of the degree of braking desired.

Controllers are available with a braking unit only or as a complete braking and starting unit for either nonreversing or reversing service. A circuit breaker, a fusible or nonfusible disconnect, and other modifications can be added to any of the systems. **Westinghouse Electric Corp.,** P.O. Box 2099, Pittsburgh 30, Pa.

Circle 460 on Inquiry Card



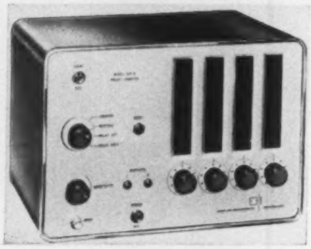
Solenoid Valve

Designed for filling operations, hydraulic systems and elevators, solenoid valve provides independent controls for manual opening, adjustment of flow, and opening and closing speeds. Known as Type HV, the valve can be mounted on piping running at any angle. It is available in all standard sizes from ½ to 2 inches; maximum capacity is 300 psi.

Four independent controls are grouped together for convenience: Flow adjustment, closing speed adjustment, opening speed adjustment, and manual opening stem. The flow adjustment increases or decreases flow through the valve. Closing and opening adjustments are made independently and positively; neither adjustment has any effect on the other. The manual opening stem allows operation of the valve in case of power failure or emergency. **J. D. Gould Co.,** 4707 Massachusetts Ave., Indianapolis 18, Ind.

Circle 461 on Inquiry Card

Counting Controllers



Developed to automatically count and control up to 1 million events, Model 310 preset counters are available in five types ranging from two to six decades. The units have been designed as high speed, direct reading electronic counters of the coincident type and will control any operation or activate an alarm after a preselected total count has been reached. Any electrical, mechanical or optical event which can be converted into electrical impulses can be counted and controlled. Devices to effect this conversion may be photocells, magnetic coils, switches and suitable transducers for pressure, temperature, velocity, acceleration, displacement, etc.

A few of the applications are: Batching and packaging of pills, bottles, bottle caps, canned goods, penpoints, machine parts, electronic components, etc., in exact preselected quantities; controlling the exact length of stock in cutting operations and control of high speed machinery. As an optional feature, a mechanical register to indicate batches (gross, dozen, etc.) or total count is available. **Computer-Measurements Corp.,** 5528 Vineland Ave., N. Hollywood, Calif.

Cicrle 462 on Inquiry Card

Meter Relays

Designed for use in special applications as well as standard alarm, control and limit setting circuits, series of meter relays features a simplified design with platinum alloy contacts and increased contact force, minimizing sticking and providing a high degree of reliability. The relays are the nonlocking type, available in 2-inch dc and 3-inch ac and dc models as microammeters, milliammeters, ammeters, millivoltmeters and voltmeters. Pyrometer types with bimetal compensation are also available. Four contact arrangements can be supplied. **Simpson Electric Co.,** 5200 W. Kinzie St., Chicago 44, Ill.

Circle 463 on Inquiry Card

Magnetic Disk Brake

Brake unit is designed for application on electric motors to be operated in atmospheres where combustible dust creates a hazard. Designated the 700 series, the brakes have maximum torque ratings of 10, 25, 50 and 75 ft-lb, floor or motor mounting. The dust and explosion-proof model supplements a line of standard magnetic transmission equipment for use on 1/20 to 100-hp motors. **Stearns Electric Corp.,** 120 N. Broadway, Milwaukee 2, Wis.

Circle 464 on Inquiry Card

Decade Interval Timer

Used for the control of timing sequences, decade interval timer is designated Model 100. The unit is calibrated in thousandths of a second with a maximum time interval of 11.110 seconds. For a large variety of switching operations to be controlled by the timer, four separate switching circuits are available from the start relay and four more from the stop relay. Any desired time interval within the range of the instrument may be set up within a few seconds by properly positioning the four large knobs on the front of the panel.

The timers consist of an electric circuit in which a resistance capacitance network controls the temporal interval. Timing is made al-

FINER ACCURACY
•
MINIMUM MAINTENANCE
•
LOWER GAGING COSTS
Presenting the new
DEARBORNAIRE

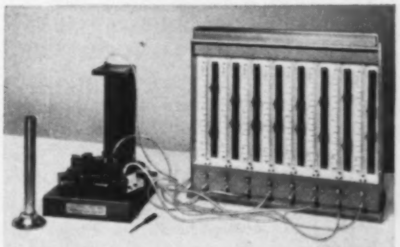
DEARBORNAIRE

COLUMN-TYPE AIR GAGING INSTRUMENT

Never before has there been an air gage instrument quite like the new Dearbornaire! For it incorporates a host of advanced design features that give you greater versatility and ease of operation with finer accuracy, minimum maintenance and lower gaging costs.

The characterized internal taper of its exclusive new glass tube assures positive linear accuracy over the full extent of the calibrated scales. Its zero-centered scales permit faster and easier reading . . . whether used for normal parts inspection, for statistical quality control, or as a tool setting gage. Interchangeability of its basic component parts simplifies conversion from one amplification to another . . . saves time, cuts costs. What's more, Dearbornaire's new higher rated pressure system and built-in circuit restrictions make it virtually self-cleaning . . . eliminate nuisance interruptions for service, reduce down-time to a minimum.

Single and multiple column instruments available now in standard amplifications of 1250-1, 2500-1 and 5000-1. Free demonstration arranged upon request. Write for complete information today!



● Multiple column Dearbornaire instrument and a special fixture equipped with Dearborn contact cartridges to check eight close tolerance dimensions at one time.

AIR GAGE DIVISION **DEARBORN GAGE COMPANY**

22038 BEECH STREET DEARBORN, MICHIGAN

Circle 591 on Inquiry Card

PERFORMANCE

O-M Tie-rodless (round line) Air and Hydraulic Cylinders rated to 500 psi Air; to 1500 psi Hydraulic.

• SMOOTH • POWERFUL • DEPENDABLE

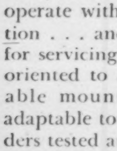
O-M

CYLINDERS
TIE-RODLESS

• air and hydraulic
• meet JIC standards

O-M Tie-rodless Air and Hydraulic Cylinders deliver peak performance at low or high speeds. They are simple and unique in design . . . have no tie rods or projecting end caps . . . fit easily in unusually close quarters . . . operate with lowest co-efficient of friction . . . and are readily disassembled for servicing. Besides, the ports can be oriented to any position. Interchangeable mounts make O-M Cylinders adaptable to any installation. All cylinders tested at rated operating pressures before shipment.

Available in full range of sizes (1½" to 8" bores) with standard, 2 to 1 or oversize rods.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ORTMAN-MILLER MACHINE COMPANY
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☐ Have Representative call
☐ Send Bulletin 101A (Round Line)
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Address_______________
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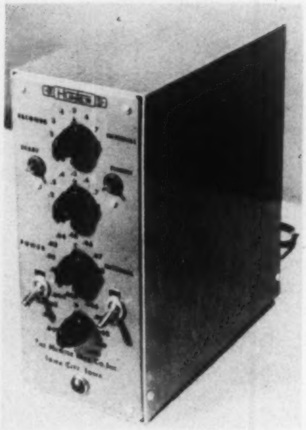
Circle 592 on Inquiry Card



most completely independent of voltage fluctuations, tube and relay characteristics. By using several timers, it is possible to generate a number of intervals in sequence, each independently variable, by allowing each timer to energize a subsequent one. A series arrangement of timers permits automatic self-recycling. **Hunter Mfg. Co.**, 930 S. Linn St., Iowa City, Iowa.

Circle 465 on Inquiry Card

Electrohydraulic Controls

Combining the best features of electronic signal sensing with hydraulic control of variable delivery pumps, hydraulic motors, cylinders and similar equipment, transistorized servoamplifier and electrohydraulic servovalve make possible electrohydraulic control of industrial machinery. The building block units make it practical to apply hydraulic power to many applications previously limited to electric drives. They also provide precision control of existing hydraulic equipment which previously could not be controlled automatically.

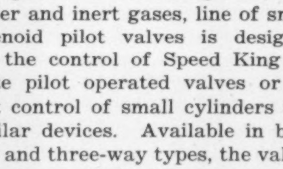
The amplifier is designed to receive signal inputs from any standard 60-cycle ac signal source. The user can provide manually variable controls, can make the control source a function of position, velocity or other command variable, or can utilize input signals from tracers or computers. The amplifier is designed for parallel summation, ratio comparison, or series summation of input signals. Output is designed to power a balanced single load, or split loads, of as high as 5w.

The amplifier supplies the driving power for the three-way servovalve (illustrated) which, in turn, controls the flow of oil to hydraulic or rotary motion drives. The single-stage servovalve is driven by a high performance torque motor and is available in ratings up to 10 gpm and 3000 psi. Linear motion control can be applied to hydraulic presses, reciprocating drives used in planers, grinders or saw mill carriages, and in a wide variety of straight line positioning applications. Rotary motion applications include lead screw feeds, spindle drives, and processing machinery which requires precise control of shaft rotation. Control combinations possible with the devices include numerous types of feedback. **Machine Controls Div., Minneapolis-Honeywell Regulator Co.**, 1400 Soldiers Field Rd., Boston 35, Mass.

Circle 466 on Inquiry Card

Solenoid Pilot Valves

Capable of handling air, oil, water and inert gases, line of small solenoid pilot valves is designed for the control of Speed King remote pilot operated valves or direct control of small cylinders and similar devices. Available in both two and three-way types, the valves are also used in laboratories and on precision production equipment where accurate control and quick response are required. Capacities range up to 23.8 cfm air and 3.8 gpm hydraulic. The valves are capable of controlling over 600 cycles per minute.



Units are available with or without integral junction box, which is large enough to accommodate 6-inch taped pigtail leads. Cylinder ports are tapped ¼-inch NPT and electrical conduit connections are tapped ½-inch NPT. Valves can be supplied with subbase for direct pipe connection, or drilled for mounting on the customer's manifold. Solenoid coils are supplied for 3 to 300v dc, 6 to 550v ac, and 25 to 60 cycles. **Valvair Corp.,** 454 Morgan Ave., Akron 11, O.

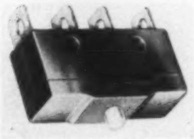
Circle 467 on Inquiry Card

Time Delay Relays

Developed for time delay applications requiring frequent time adjustments, line of dial head Agastat time delay relays consists of a pneumatic timing head, a solenoid assembly, a switch, a coil and terminals. Dial markings permit easy calibration for accurate adjustment, and each dial is color coded to identify the timing range. Four timing ranges are available in the dial head model: White, for time periods from 1/10 to 3 seconds; yellow, for time periods from 1/10 to 10 seconds; red, for time periods from 10 seconds to 2 minutes; and blue, for time periods from 30 seconds to 15 minutes. Each unit is adjustable within these timing ranges, and a complete adjustment is attained by one revolution of the dial.

The relays are relatively unaffected by wide temperature changes from −65 to 160F. They can be supplied for continuous ac duty and for continuous or intermittent dc service. Relays are available for ac operation at all standard voltages from 6 to 550v, 60 cycles and 25 cycles. For dc operation, they are made for all standard voltages from 6 to 230v. **A'G'A Div., Elastic Stop Nut Corp. of America,** Elizabeth, N.J.

Circle 468 on Inquiry Card



Snap Action Switches

Design of BM-12,000 series of subminiature snap action switches combines small size with high current carrying capacity of 10 amp at 115v, or 230v ac or 28v dc, inductive load. Switch is capable of operating in temperatures as high as 350F and as low as −100F in controlled atmosphere.

Long life is assured through use of rolling spring principle—up to 10,000,000 cycles mechanical life. Four terminals are provided for wiring double circuits where required. Entire unit is housed in a plastic case and can be adapted to any present type of actuator. **Acro Mfg. Co.,** Columbus 16, O.

Circle 469 on Inquiry Card

GEM-17 DIAL INDEX TABLE

TRUE GENEVA MOTION

FOR FAST, *ACCURATE* AUTOMATION OF ASSEMBLY *and* MACHINING OPERATIONS

This new, high precision index table is accurate to plus or minus 0.001 in. on a 13 in. dia. work circle; can position work in as little as ½ sec.; indexes a 1,000 lb. fixture load.

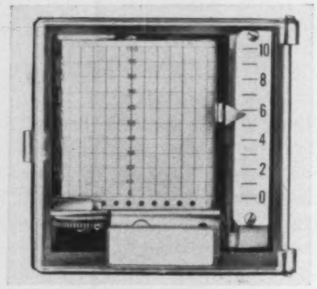
BASIC SPECIFICATIONS: Standard Number of Stations—6, 8 or 12; 3 and 4 skip. Motor—Rotary air, fluid, or electric. Dial Plate—17 in. dia. standard; larger plates available. Rotation—Either direction. Interlock—Limit switch operated directly off locking bolt. Weight—200 lbs.

Gray engineers will help you adapt GEM-17 to your use. For recommendations, send specifications of your application. Illustrated brochure GE-21 and prices on request.

GRAY EQUIPMENT COMPANY

13600 Ford Road • Dearborn, Michigan • Telephone: TIffany 6-7573

Circle 593 on Inquiry Card

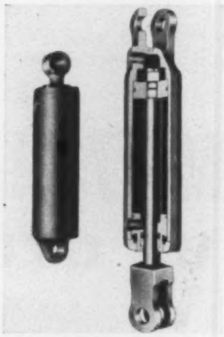


Potentiometer Recorder

Self-balancing electronic potentiometer which gives a continuous record on a 3-inch strip chart can be used to measure and indicate or record any variable which can be converted into an electrical quantity, such as temperature, pressure, flow, speed, pH, smoke density, resistance, etc. The Dynamaster recorder, which uses standard components, is housed in a case only 5 inches square.

The small instruments are also furnished in indicating models. The indicating and recording chassis are both built for full plug-in service, and can be quickly interchanged with each other. With the electronic recorders and indicators, which are available in either potentiometer or ac bridge models, a complete process can be monitored, making possible a graphic panel or console type operation where desired. **Bristol Co.,** Waterbury 20, Conn.

Circle 470 on Inquiry Card



Gland Cylinders

Heavy duty double and single-acting cylinders employ a patented gland design and method of prestressing the snap ring within the cylinder which permits streamlined design, easy maintenance and perfect rod alignment. Piston rods are heavy chromed with aluminum alloy pistons to prevent corrosion and scoring. V-ring rod packings are independently adjustable. Bronze wiper rings on rods are used to prevent foreign material from entering cylinders. Cylinders are honed seamless steel tubing with welded cast steel clevis. Design of the clevis prevents cylinder distortion during welding of the cylinder. Cylinders are available from 2½ through 4-inch bore and from 1-inch through 18-ft bore stroke; they are designed for operation up to 1500 psi. **Densmore Engineering Co. Inc.,** 235 E. Greenleaf St., Compton, Calif.

Circle 471 on Inquiry Card

Vibratory Feeder

Designed for accurate feeding operations where relatively small amounts of materials are involved, miniature magnetic vibratory feeder was developed specifically for use in association with packaging and weighing machines and similar

Zenith AUTOMATIC CONTROLS

ARE ENGINEERED TO
GIVE YOU GREATER ACCURACY!

Rely on field-proved ZENITH Controls for trouble-free, maintenance-free operation . . . long-lasting performance and accuracy.

The ZENITH line includes: Magnetic Contactors; Remote Control Switches; Automatic Transfer Switches; Reset, Interval, Process and Impulse Timers; Program Clocks . . . and special units to order.

INTERVAL TIMER

PROCESS TIMER

MULTI-CIRCUIT TIMER

Write Today for Latest ZENITH Bulletin
See classified telephone directory for name of local distributor

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145 WEST WALTON STREET • CHICAGO 10, ILLINOIS

Circle 594 on Inquiry Card

TRU-O-SEAL

TEFLON SEAL

STOPS PIPE THREAD LEAKS

PAT. PENDING

Satisfaction Guaranteed Or Money Back TRIAL OFFER

TRU-O-SEAL Fittings are guaranteed to seal pipe thread connections permanently against all oils, practically all known chemicals and gases; to seal under high pressures or vacuum; to withstand —280° to plus 500° F.; to eliminate "overtightening" damage and pipe dope. Available in ⅛" to 2½" pipe thread sizes.

$10.00 Trial Offer No. 1: six ⅛", ten ¼", six ⅜", eight ½" pipe thread TRU-O-SEAL Fittings.

$10.00 Trial Offer No. 2: six ½", ten ¾", four 1" pipe thread TRU-O-SEAL Fittings.

Send order to

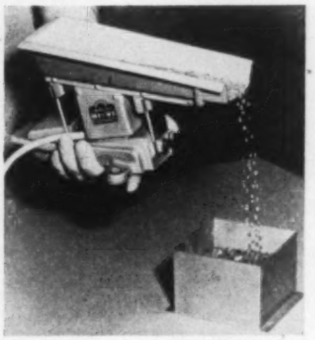
TRU-O-SEAL DIVISION
Flick Reedy Corporation
2015 N. Hawthorne Melrose Park, Ill.
"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.

① Thread TRU-O-SEAL on pipe or fitting (no messy pipe "dope" needed). SEAL SIDE

② Thread pipe or fitting 4 threads into port. Point in desired direction.

③ Tighten TRU-O-SEAL to complete leakproof assembly (only light torque required).

Circle 595 on Inquiry Card



equipment. Called the FE¼, the unit can be supplied with feeder trays of various types—flat, tubular, half-round, V-shape and specials—which adapt it to such operations as feeding pills a single unit at a time, bagging and bottling, adding reagents to chemical systems, etc. The feed rate of the unit is readily controllable, up to a maximum of 500 lb (sand) per hour.

The feeders operate directly off an ac line, requiring no source of rectified power. Their magnetic system combines an ac electromagnet with an Alnico V permanent magnet; the resulting forces act to alternately pull down and back, and push up and forward on the tray assembly.

In operation, material in the tray, first given a sharp upward and forward impetus, falls vertically to a new position forward in the tray as it is moved downward and back by the reciprocal action of the magnetic system. Repeated at high speeds, the vibratory pattern causes material in the tray to move steadily forward in a rapid series of hops. The rate of feed can be regulated by means of a remote control which contains no rectifier but is operated manually as a simple rheostat to vary the voltage across the unit, with resulting immediate changes in the feed rate. **Eriez Mfg. Co.,** Erie 6, Pa.

Circle 472 on Inquiry Card

Motor Drives

Suitable for servowork as well as for remote positioning applications, motor drives are also used with Variac autotransformers. Ganged Variacs as well as single units can be supplied with motor drives in open or completely enclosed mountings. Full scale traverse rates of 4, 8, 16, 32, or 64 seconds are available on all models, and a drive with a 2-second traverse is available on Type W2, W2G2, or W5 Variacs. The 2 and 4-second drives are intended for servo-operations and use a motor with low moment of inertia and high angular acceleration. Medium speed drives use the same motor with different gearing. Limit switch stops are used on the 32 and 64-second drives, but are optional on other models.

The drives feature simplicity of design. The gear reducer motor is attached to a mounting plate which in turn is ganged to the Variac. A gear coupling between the motor and Variac shaft is used to reduce alignment problems and to allow the use of one motor for a range of drive speeds. **General Radio Co.,** 275 Massachusetts Ave., Cambridge 39, Mass.

Circle 473 on Inquiry Card

START YOUR AUTOMATION PLANNING WITH

SWANSON

STANDARD INDEXING MACHINE CHASSIS

Save valuable engineering time and cut the cost of building your automatic and special purpose machines

You can get the benefits of automation *without making a large capital expenditure.* You can easily justify automation projects by building your special machinery around a Swanson standard chassis.

These versatile "packaged" units provide the basic chassis for a wide range of special purpose automatic machines. Because they eliminate much of the engineering and building formerly required, Swanson units lower costs and shorten completion time . . . considerably broadening the applications of automation.

Series B Turret Index Model, with phantom view of typical mounting brackets, tooling.

Write for Bulletin 356-A. It describes the complete line of Swanson Standard Index Machine Chassis.

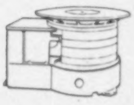
SEC

SWANSON-ERIE
CORPORATION
814 EAST EIGHTH ST., ERIE, PA.

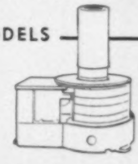
ENGINEERS AND BUILDERS OF AUTOMATIC AND SPECIAL PURPOSE MACHINES SINCE 1919

OVER 200 STANDARD MODELS

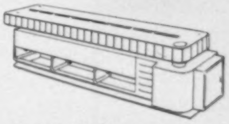
Series B & C Turret Index Models—for medium and light applications.



Series H Turret Index Models—for heavy duty applications.



Series K Turret Index Models—for heavy duty applications with center column tool mounting.



Series L Auto-Tran Straight Line Indexing Chassis—for automatic or semi-automatic assembly and processing operations.

Circle 596 on Inquiry Card

catalogs and literature

Latest automation information. For copies use card page 17.

Electrohydraulic Converter

Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.—8-page bulletin — Low level electrical input signals are converted to hydraulic power for the production of thrust or torque by Electrojet unit which is described in Application Bulletin No. 38.1. Applications such as position and floating control are illustrated and described. Operating data, specifications, and available types of Electrojets are discussed.

Circle 474 on Inquiry Card

Mechanized Heat Treating

Surface Combustion Corp., Toledo 1, O.—8-page bulletin — Automatic heating for forming, hardening, tempering, normalizing, annealing, carburizing, carbonitriding, and carbon restoration are possible with line of heat treating equipment discussed in Bulletin SC-176. Isometric drawings illustrate 24 basic furnace mechanisms; photos and diagrams show the steps which are used in building automated lines.

Circle 475 on Inquiry Card

Milling Spindles

Standard Electrical Tool Co., Precision Spindle Div., 2488-96 River Rd., Cincinnati 4, O.—6-page pamphlet—Used for milling, boring, routing, drilling and a variety of other applications, line of spindles is described in Bulletin C15. Motorized units are available in sizes up to 200 hp; those with an independent drive are available in sizes up to 60 hp. Photographs and specifications of several models are included.

Circle 476 on Inquiry Card

Metal Finishing

Minnesota Mining & Mfg. Co., Dept. F-308, 900 Fauquier St., St. Paul 6, Minn.—12-page bulletin — Polishing applications of new design of abrasive wheels in appliance, aircraft, farm equipment, metal furniture, dairy equipment, machinery, and other metalworking industries are given in case history form in illustrated bulletin. Large size wheels which are designed for use on floor lathes, semiautomatics and fully automatic polishing machines, and portable wheels for use on floor and bench lathes, and for portable and flexible shaft grinders are shown. Wheels of the new design replace set-up wheels, felt wheels, sisal and rag buffs, and greaseless compound wheels.

Circle 477 on Inquiry Card

Miniature Speed Reducers

Metron Instrument Co., 432 Lincoln St., Denver 3, Colo.—4-page pamphlet—Series 10 and 11 Bantam speed reducers which are used in servomechanisms, computers, flow controls, process controls, recorders and numerous other applications are described in Bulletin No. 98. Photographs illustrate applications of the reducers which are available in standard and antibacklash models; complete selection chart is included.

Circle 478 on Inquriy Card

Gaging With Air

Sheffield Corp., Div. 610, Dayton 1, O.—12-page bulletin — Uses for precise production gaging with air illustrated in Catalog No. IPC-6-56 include checking of holes for diameters, squareness with a face, camber, taper, concentricity and checking of external dimensions and surfaces for contour, flatness, etc. Principles of operation and basic tooling elements are shown as well as multiple-dimension automatic checking units.

Circle 479 on Inquiry Card

Automatic Storage Controls

Stephens - Adamson Mfg. Co., Aurora, Ill.—4-page pamphlet—Line of bin-level control switches is described in Bulletin 11-0. Available in three styles—normal duty, explosion proof and heavy duty — the self-contained units are mounted in bins or tanks to sense the level of bulk materials or liquids, and subsequently to control conveyors or elevators and to operate warning light or horn. Photographs, specifications and applications of the devices are included.

Circle 480 on inquiry Card

Three-Dimensional Cams

Parker Stamp Works Inc., Cam Div., Franklin Ave., Hartford, Conn.—4-page pamphlet—Used in automation, instrumentation, aircraft controls, etc., three-dimensional cams are discussed and illustrated in pamphlet. The output of a three-dimensional cam is a variable determined by two independent variables in accordance with relationships designed into the cam.

Circle 481 on Inquiry Card

Motor Pulleys

Reeves Pulley Co., Div., Reliance Electric & Engineering Co., 1225 Seventh St., Columbus, Ind.—8-page bulletin—Used to convert any standard motor, ⅛ to 1½ hp, into a variable speed drive, 800 Series Vari-Speed Jr. motor pulleys are described and illustrated in Bulletin V-563. Diagrams and rating tables facilitate selection of the proper pulley from the available five sizes.

Circle 482 on Inquiry Card

Annunciator Systems

Panalarm Div., Panellit Inc., 7401 N. Hamlin Ave., Skokie, Ill.—32-page catalog—Used to direct operator attention to an off-normal condition in processes in aircraft, automotive, chemical, glass, nuclear, paper, petroleum and steel industries, line of annunciator systems is described in Catalog 100B. Photographs and specifications of several models in the line are included, along with information on remote equipment and components.

Circle 483 on Inquiry Card

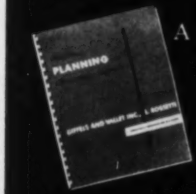
Radiation Pyrometers

Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa.—26-page catalog—Used in heat treating furnaces, induction heating for forging, high speed salt baths, rotary and car-type kilns, line of Radiamatic pyrometers is the subject of Catalog C 93-1. Illustrations and brief descriptions of five models and accessory equipment are included. Also

WHO
uses professional engineering services

Manufacturers, large and small—in all fields of industry, are turning to professional engineering for better manufacturing methods, improved processing facilities, greater output and lower production costs. For more than thirty years Giffels & Vallet, Inc. has provided a comprehensive planning and engineering service to a widely diversified group of industries.

This service is flexible and adaptable. Whether the project is a complete new plant, or the modernization of present facilities—including process development, equipment design, automated machinery, materials handling flow—Giffels & Vallet, Inc. offers a complete professional service to meet the specific requirements of each individual client. These services are set forth in a special Planning Brochure.



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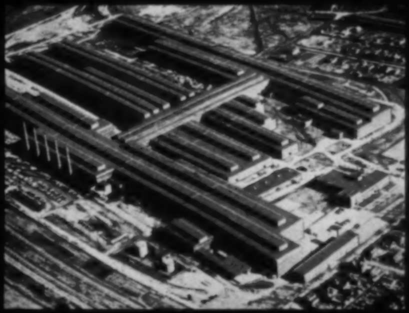

INDUSTRIAL ENGINEERING DIVISION

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Engineers
Serving
Industry
for Over
Thirty
Years

BARNES GIBS RAYMOND

Circle 597 on Inquiry Card

covered are indicators, recorders, controllers and millivoltmeter pyrometers for use with the Radiamatic units.

Circle 484 on Inquiry Card

Deep Hole Drilling

Lahr Machine & Tool Corp., 3400 *Maplewood Ave., Toledo* 10, *O.—4-page pamphlet*—Model 662F2 deep hole drilling machine is illustrated and described in pamphlet. Features of the driller include centralized control station, high pressure coolant system, large mobile drill head range, and 50 sq ft machine bed. Illustrations of the components of the drilling machine are included.

Circle 485 on Inquiry Card

Automatic Injection Molding

F. J. Stokes Corp., 5500 *Tabor Rd., Philadelphia* 20, *Pa.—8-page bulletin*—Automatic molding, degating, ejecting and sorting are provided by 2-oz injection machine, Model 701, described in Bulletin 565. Close-up photographs illustrate operating sequence. Features of the machine are discussed and specifications are listed.

Circle 486 on Inquiry Card

Industrial Data System

Scientific Instruments Div., Beckman Instruments Inc., 2500 *Fullerton Rd., Fullerton, Calif.—16-page booklet*—Used for monitoring, recording and processing information, Model 111 data system is the subject of Bulletin 494. Applications for the system include use in the chemical process industries, metal smelting and refining, structural testing, steel production, engineering studies involving transformers, jet engines, etc. Discussion of the components of the system and application photographs are included.

Circle 487 on Inquiry Card

Gas Analyzers

Leeds & Northrup Co., 4907 *Stenton Ave., Philadelphia* 44, *Pa.—8-page bulletin*—Used for measuring gas in air or binary mixtures, Types G and H Speedomax thermal conductivity gas analyzers are discussed in Folder ND46-91(6). Three methods for automatic process control — electric, electropneumatic and straight pneumatic — are described and illustrated. Application information and specifications of each type are included.

Circle 488 on Inquiry Card

Barrel Finishing Systems

Almco Div., Queen Stove Works Inc., Albert Lea, Minn.—52-page catalog—Skip-station and inline automated barrel finishing systems are among the types illustrated and described in comprehensive catalog. Explanation of barrel finishing and the variables involved, Almco sample processing laboratories, various types and uses of barrel finishing machines and accessory equipment, and types of media and finishing compounds are covered. Numerous illustrations and specifications are included.

Circle 489 on Inquiry Card

Tube Selection

Parker Appliance Co., Tube & Hose Fittings Div., 17325 *Euclid Ave., Cleveland* 12, *O.—8-page bulletin*—Flow requirements, pressures, severity of service and temperatures are among the factors considered in tube selection data given in Catalog File 4305. Charts and tables assist in the proper selection of tubing as to size, wall thickness and materials for various operating conditions.

Circle 490 on Inquiry Card

Continuous Noncontacting Gage

Pratt & Whitney Inc., Charter Oak Blvd., W. Hartford 1, *Conn.—12-page bulletin*—X-ray gages for metals and Beta ray gages for nonmetallic materials are the types of continuous noncontacting gages described and illustrated in bulletin. Application photographs, engineering data, optional accessory equipment, and control units for mill control, classifying and production analysis are included.

Circle 491 on Inquiry Card

Automatic Reversing Pumps

Tuthill Pump Co., 939 *E. 95th St., Chicago* 19, *Ill.—12-page bulletin*—Capable of being driven in either direction of rotation without changing direction of flow or port positions and without the use of check valves, Model R series of rotary, internal gear, positive displacement pumps is descibed in Catalog No. 105. Automatic reversing pumping principle, tables showing dimensions and parts of different types in the series, performance curves and mounting diagrams are included.

Circle 492 on Inquiry Card

Combustion Control

Cleveland Fuel Equipment Co., Dept. A, 1111 *Brookpark Rd., Cleveland* 9, *O.—20-page booklet*—Provision of automatic means for sensing the heat requirements to assure correct proportioning of fuel and air under optimum conditions is discussed in booklet entitled, "Control Fundamentals . . . Their Application to Combustion." Basic control fundamentals common to all systems, key components of combustion control systems and description of their interrelationship in the operation of a complete control system are covered. Dictionary of control terminology is also included.

Circle 493 on Inquriy Card

Automatic Stitcher and Shear

Herr Equipment Corp., 1200 *Vine St., N.E., Warren, O.—4-page pamphlet*—Developed to increase the output of continuous strip processing lines, combination stitcher and shear machines are described in Bulletin 563. Stitcher permits the lead end of a new coil to be joined to the trailing end of a preceding coil; twin-cut shear cuts out the stitched section preparatory to recoiling.

Circle 494 on Inquiry Card

Hydraulic Oil Coolers

Vickers Inc., Box 302, *Detroit* 32, *Mich.—8-page bulletin*—Used in industrial hydraulic systems, line of water and air type hydraulic oil coolers is the subject of Bulletin 55-69. Selection charts, installation drawings, dimensions and specifications for the complete line are given. Oil cooler circuit accessories such as temperature control valves, bulb wells, etc. are also discussed.

Circle 495 on Inquiry Card

Guided Pallets

Rapids-Standard Co. Inc., 342 *Rapistan Bldg., Grand Rapids, Mich.—28-page catalog* — Applicable for operations which require a number of processing steps and careful handling, guided pallet conveyor system is described and illustrated in catalog. Several field reports and photographs of system in actual use in furniture and cabinet plants are included. Specifications, diagrams and information on system components are also given.

Circle 496 on Inquiry Card

Magnetic Information Storage

Electronics Div., Monroe Calculating Machine Co., Morris Plains, N. J.—8-page bulletin—Designed for the storage, transfer and synchronous circulation of digital data, magnetic drum units are illustrated and described in bulletin. Also covered are magnetic selection systems for use in conjunction with the drum units. Cutaway photographs, specifications and complete description of various models in the line are included.

Circle 497 on Inquiry Card

Batch Weighing Controls

Fairbanks, Morse & Co., Fairbanks-Morse Bldg., Chicago 5, *Ill.—16-page booklet*—Electronic program control as used in batch weighing and Batchetron electronic control system are described in Bulletins ED-14 and ED-15. EPC system is used to electronically administer the control of successive manufacturing operations. Its applications in weigh batching by punched card control are described and illustrated. Batchetron is designed to control batch weighing by dial setting of any type of material that can be handled into batch hoppers by piping, screw conveyors, etc. Typical batching operation, instrumentation, etc. are covered.

Circle 498 on Inquiry Card

Key Switches

Stromberg-Carlson Co., Div., General Dynamics Corp., 100 Carlson Rd., Rochester 3, N.Y.—22-page booklet —Developed for electromechanical switching purposes, line of key switches is described and illustrated in booklet. Types available are cam lever keys with surface or flush mountings, twist type and pushbutton keys on individual mountings or in strips of standard size. Information on a variety of cam, indicating and plunger type keys is included.

Circle 499 on Inquiry Card

Finishing Systems

R. C. Mahon Co., Detroit 34, Mich. —*12-page bulletin*—Diversified industrial equipment for spray, dip or flow coating, cleaning, pickling, rust proofing, drying and baking, is illustrated in Catalog No. A-657. Automatic machine for cleaning cylinder blocks and engine crankshafts, automatic dip coating device, and multiple pass oven with automatic transfer are among installations shown.

Circle 500 on Inquiry Card

Solenoid Valves

Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.—32-page catalog —Both fully automatic and manual reset valves in two, three and four-way models are illustrated and described in Catalog No. 201. Valve selection chart provides application data and guide to page on which each type is discussed. Flow charts are also included, along with information on strainers and filters. Photographs and specifications of various models are given.

Circle 501 on Inquiry Card

Fluid Drives

American Blower Corp., Detroit 32, Mich.—8-page bulletin — Adjustable, stepless speed control for industrial machinery is supplied by Type VS Class 2 Gyrol fluid drives which are described in Bulletin 9819. Selection tables for the line, which is available in 1 through 25 hp range, are included. Installation drawings and dimensions of the drives are given.

Circle 502 on Inquiry Card

Self-Loading & Unloading Truck

Ross Carrier Div., Clark Equipment Co., Benton Harbor, Mich.—16-page booklet—Capable of loading itself in 5 seconds with loads up to 50,000 lb, traveling at speeds up to 56 mph and unloading itself in 3 seconds, materials handling truck is illustrated and described in booklet. Photographs show the Ross Carriers being used in transportation of scrap iron, cotton bales, pre-fab homes, lumber, concrete blocks, girders and columns, pineapples and bourbon. Uses in the metalworking, petroleum and steel industries are also illustrated.

Circle 503 on Inquiry Card

DC Power Supplies

Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.—8-page bulletin—Used for intermittent, variable and pulse loads, or high amperage loads, line of constant voltage dc power supplies is described in Bulletin DC-235. Six power supply models, which include a constant voltage transformer, a germanium power rectifier and high capacitance filter, are illustrated, with their specifications and performance characteristics given.

Circle 504 on Inquiry aCrd

Metal Cleaning Equipment

Solventol Chemical Products Inc., 15841 Second Blvd., Detroit 3, Mich. —*4-page pamphlet*—Spray washers, rotary drum washers, agitating, pickling and drying units are illustrated and described in pamphlet. Construction features of the equipment are given, along with photographs of several types of metal cleaners.

Circle 505 on Inquiry Card

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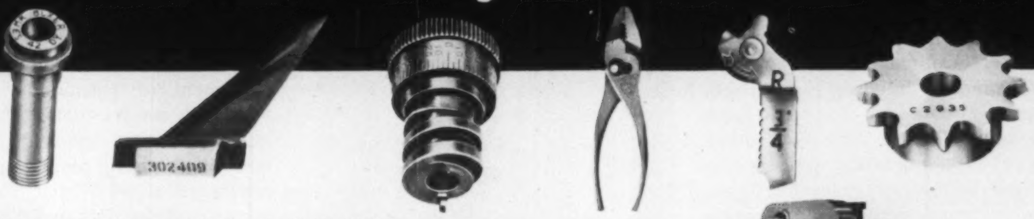

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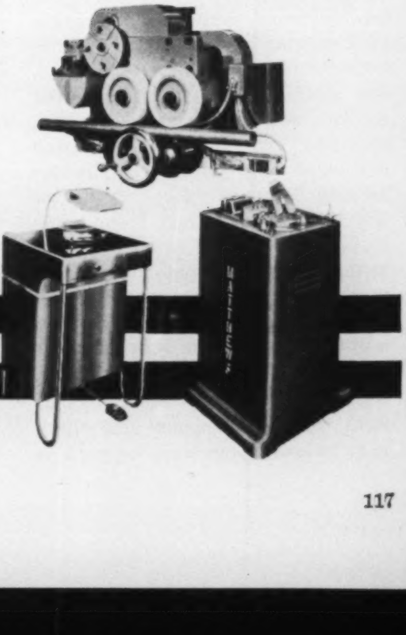

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Circle 598 on Inquiry Card

AUTOMATION abstracts

PRESS UNLOADERS AND DIE DESIGN

By RICHARD H. MELVIN
Sahlin Engineering Co. Inc.
Birmingham, Mich.

AUTOMATION in stamping plants arose because of the need for maintaining an even and constant flow of parts through a specified series of operations. It necessitated presses and related automatic equipment sequencing each operation or cycle rather than relying upon the operator's skill for timing requirements.

In the past, conveyor belts, chutes and other equipment moved work from one press to another. But, for the most part, one or more operators were required for the actual loading and unloading. With the steady rise in labor costs, manufacturers began to look for some means of increasing production per manhour. This set the stage for the introduction of automatic feeders, unloaders, turnover and transfer mechanisms.

Automatic feeding machines, generally conceded to have been among the first practical steps toward reducing costs, appeared on various production lines. But these feeders were limited. They could load only as fast as parts could be removed; consequently, production was geared to machines that had to be manually unloaded. The swinging arm type unloader was developed as a solution to the unloading problem. As a result of the knowledge gained from early installations, the iron hand, a swinging arm type unloader, underwent a continuous program of design improvements. This included a standardization on four sizes for handling a variety of work ranging from such large stampings as auto roofs, ¼-panels and bath tubs to such small work as garnish mouldings and ash trays.

Air operated and electrically controlled, the unloader is synchronized with the movement of the machine on which it is mounted and can be timed to whatever phase of the machine cycle is desired. When the ram, or slide of the press descends and completes its forming or blanking operation, the unloading device begins its cycle. As soon as the ram begins to rise the small jaw cylinder is actuated, which causes the movable parts of the jaw assembly to travel forward and grasp the panel. When the slide has risen sufficiently, the stamping is lifted out of the die, swung clear of the press and placed on a conveyor or transfer loading machine *Fig.* 1. An adjustable delay permits co-ordinating the press ram action with the main power or lift cylinder of the iron hand which raises the arm, pivoting it about a vertically moving point. Cam followers attached to this arm travel a confined track thus providing the panel lift and unloading arc unique with the iron hand. After releasing the stamping, the hand returns to the waiting position for the beginning of another cycle. If required, stampings can be stacked or turned over by the iron hand for the next operation.

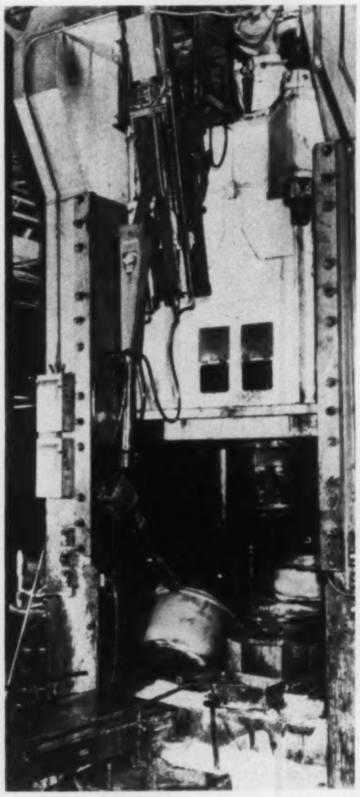

Fig. 1—Installation of press unloader on 1850-ton hydraulic press at Whirlpool-Seeger Corp.'s Clyde Div. plant. The deep drawn basket is first lifted upward to clear the die and then swung out of the press and dropped onto a conveyor.

In addition to the functional development of mechanical or iron hands themselves, there were related problems limiting advancement in stamping plants—problems which still exist today. These center around the dies and directly influence both the effectiveness of automation and the extent to which it may be installed. Mechanization of a line most assuredly realizes benefits safety-wise. However, to automate four dies with a resulting production of 400 panels per hour is of no gain if flange die conditions permit only 150 panel maximum.

A study of operating conditions in relation to certain characteristics of die design shows that the installation of devices would be a simpler task if adequate consideration were given to actual operating conditions in a stamping plant.

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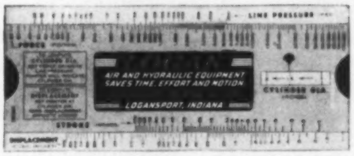
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Specific examples of die design features encountered which cause the most significant problems both for unloading and loading are the following:

Panel crossover—This situation is caused by not following through the operational line-up while designing double dies to be used in one sequence. It is characterized by two panels which are fabricated on the right and left sides respectively in one double die, are reversed to left and right sides respectively in the following double die and then again positioned for fabrication as in the first instance.

Multiple dies—This situation in itself is due to press availability. However, the manner in which panels, such as seat sides, are often flanged and trimmed should be studied for panel movement. For example, two panels (right and left) receive two fabrications in a four-die setup. In the first stage, the panels are nested in the outer dies. The sections over which the metal is flanged face to the outside. Consequently, the panels must be pried loose, lifted from and over the first stage dies and positioned on the second stage or inside dies. Here the flange projection is located at the front and therefore not logically positioned for unloading to the rear.

Guide pins—The positioning of a die lengthwise between guide pins sometimes hinders the unloading function. If such dies were turned 90 degrees in regard to the guide pins, the unloading function would be simple.

Included devices—Including loading or unloading devices with die design is sometimes unsatisfactory in that individual stamping facilities vary as to shut height and stroke, etc. For example, an analysis of a flange die used in the fabrication of an inner brace disclosed that the ejecting mechanism designed, constructed and attached to the die had to be removed. First, the die had been turned 180 degrees from line sequence. Secondly, the operator had to load the panel either over the device, which was impossible since its height was more than the eight-inch press stroke, or around the ejector and into the die. The latter was unsatisfactory in that the operator's vision was impaired and the panel had to be loaded into the die area fourteen inches with tongs, nested, and pulled back for gaging. The device was removed; the die turned 180 degrees for proper alignment; and the panel removed with an iron hand.

Trim—Conditions are periodically encountered which prohibit the effective installation of unloaders due to trim stock remaining either in the die proper or in the area immediately surrounding the trim steels. Occasionally, the basic design permits shedding the scrap without considerable die change. However, a study of this problem during design would aid in the installation of unloaders on this type of die.

Clearance — Adequate provision for the jaw is frequently omitted. While a die is bottomed and performing its operation the jaw normally rests outside the immediate die area. On many installations it is necessary to mill a clearance on either one or both of the die shoes. This is not only expensive and time consuming, but it is also a situation which could be corrected by providing for die cores during the design phase.

Other related problems include distance between presses, using the straight panel flow type of process, and the elimination of the need to either turn panels over or change direction while being fabricated.

The above items are gradually being remedied but the extent to which they still exist reduces the tremendous potential of stamping plant automation. A major forward step has been made by one of the largest automotive stamping divisions in the United States. This is found in their press specifications, which clearly define provisions for iron hand installations including mounting pads, overhead clearance, and air and electrical facilities engineered in the press itself.

From a paper entitled, "Evolution of the Iron Hand" presented at the ASME Machine Design Conference in Worcester, Mass., April, 1956.

CONTROLS IN WORK HANDLING

By R. L. PALMER
Research & Development Div.
Jervis B. Webb Co.

WHEN PROPERLY DESIGNED, automatic material handling between operations can do much to assure production efficiency. Specifically, it can contribute to an increased production rate; a reduction of in-process inventory and provision of a first-in, first-out basis for in-process inventory; a reduction in per-unit space requirements; a reduction in the per-unit labor content; and decreased possibilities for waste or damage to parts in process. Further, by minimizing handling by human operators it offers improved uniformity of product.

Equipment available for work handling between machine tools may be classified in three broad groups or types. The first of these types can be considered as straight-through devices which handle unit parts directly from one machine to another. The second group includes equipment that is a combination of straight-through devices, with facilities for optional storage bank. The third type is equipment for bulk transfer. This latter group is usually associated with small parts that may be combined and separated with relative ease.

Of these three, selection of the most desirable type for a particular application requires careful study, since the performance of the associated machines can be greatly influenced by the methods chosen for handling parts between them. Before adoption of any one method, all possibilities must be considered; among these are such considerations as the effects of possible downtime on machines, the value of storage banks between machines, the obsolescence of parts buried in storage racks, the significance of inventory control, and the likelihood of damage to parts. Economic factors are a prime consideration, of course, but it must be recognized that economic effects extend far beyond the first cost of an installation. Results and savings to be realized over the complete operation are of the greatest importance.

Electrical Controls

In virtually every method of handling materials between machines, regardless of the method or equipment in use, handling equipment must be controlled electrically. Experience has shown that electrical control is generally the most accurate, reliable, and flexible means available. In many instances electrical control also proves the most economical means, although power requirements for the motion of parts may be supplied by pneumatic, hydraulic, or electrical means.

A straightforward electrical approach to the control problem is usually satisfactory and, in fact, desirable. Electrical design should be based, whenever possible, on the use of standard equipment to simplify repair and maintenance. In the construction of panels, J.I.C. standards are followed widely, and control panels are normally provided for each unit or related groups of units. Whenever possible these should be mounted on the equipment they control, or as near to it as possible. Terminals should be provided for all external connections and each control should be separately fused and provided with sectionalizing disconnect switches. By using this construction, any single panel can be made inoperative without affecting other parts of the system. Further, in the event of accidental grounds, panels can be successively disconnected until the grounded condition is located.

Simplify Wiring

To simplify problems of wiring and maintenance, compliance with certain standard practices is most important. A clear-cut numbering system used for parts and wires is of great value; limit switches which have the same function should have the same root number even when mounted in separate locations. These switches may then be wired to the same numbered terminals in the unit panels with the result that the possibility of confusion is minimized. Similarly, relays in control panels should be designated by the same root number if they perform the same func-

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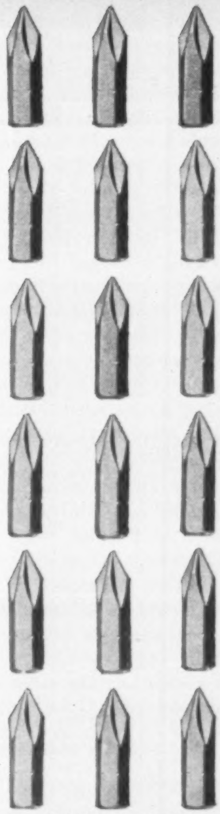

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tion.

It has been found most economical from the standpoint of wiring and maintenance to use not more than four wires to any one limit switch; for cases where additional contacts are required, relays may be used. In most applications that involve limit switches it is advantageous to wire the switches with a suitable length of four-conductor neoprene-covered cord and a polarized plug for greater ease in maintenance. The wiring itself is connected to one normally-open and one normally-closed contact and receptacles are then wired for the particular combination required at that point, whether normally open, normally closed, or both. All limit switches should have a clamp-on mounting so adjustments for timing and alignment can be made without difficulty.

Solenoid valves should be wired with a short cord and plug, and the provision of flexible hose connections between air supply, valves, and cylinders will make the replacement of defective valves simple. Decentralized controls for small units will make changes and rearrangement an easy matter since there is no disturbance of the units that remain.

Safety Considerations

To consider the system as a whole, it is very important that controls for the transfer mechanism itself are properly interlocked with the related machine tools. Provision for this interlocking should be made in the machine control panels and in the transfer panel. Interlock and safety circuits must be designed so that when power is removed from one panel it will not bring about unsafe conditions in adjacent panels. This design may require the use of additional limit switches operated directly by machine parts rather than by relay contacts in another panel. Generally, safety circuits in separate panels should also be electrically separate and the design must provide that all possible unsafe conditions will be evident and that damage to parts and machines will be prevented. Circuits and signal lights should be arranged to indicate the location of conditions which have caused the shutdown.

Safety of personnel must, of course, have a high priority in the design of any automatic handling equipment. Since the equipment normally operates without appreciable attention, all protection possible must be available to prevent injury to operators and maintenance personnel. Moving parts must be guarded as thoroughly as is possible; although removable panels may be provided where necessary for access. Suitable *Stop* buttons should be provided at appropriate locations for the protection of workmen. Local lights can be used near the push buttons and also at a central panel to indicate the location of the stoppage.

Anticipate Trouble

When designing controls for handling equipment, certain intangible considerations must also be taken into account. As factories and equipment become more complicated, every unit added becomes a part of an increasingly complex system. And as equipment and controls become more and more reliable, less and less can breakdowns be tolerated. It is essential, therefore, that instructions and diagrams for rapid trouble shooting and repair are readily available to maintenance personnel. In this connection, maintenance guides should be available for both reliable and unreliable machines. It is no doubt true that maintenance personnel know best how to repair equipment which affords them the most trouble. Therefore, there is some truth in the argument that it is the reliable machine which should have the clearest instructions and diagrams.

To mention another intangible factor, the true economy of any installation should be considered not only in terms of its first cost but also in terms of subsequent charges for down time and maintenance. It can be much more desirable to expend a somewhat greater amount for controls equipped with adequate signals to indicate trouble, if the cost of field wiring, checking, operation, and future maintenance are reduced.

From a paper entitled, "Work Handling Between Machine Tools" presented at the Twentieth Annual Machine Tool Electrification Forum sponsored by the Westinghouse Electric Corp. in Buffalo, N. Y., April, 1956.

CONSIDERATIONS IN EQUIPMENT REPLACEMENT

By GEORGE TERBORGH
Research Director
Machinery & Allied Products Institute

THERE ARE two basic requirements for a good equipment policy. The first is a reliable analytical technique for appraising the replaceability of particular pieces or groups of equipment. The second is a good administrative setup to provide management with current and systematic information on re-equipment opportunities. I have no illusion that there is any one "best" setup for the administration of equipment policy. There are too many variables to reckon with: the size of the company, the nature of the operation, the character and condition of the facilities, the personalities in management, and so on. But whatever the organizational chart, there are certain functional objectives to be achieved.

Let me simply list the principal ones. There should be continuous and systematic review of the equipment situation by an individual or staff specially trained in replacement analysis, and primarily responsible for keeping the situation under surveillance. Re-equipment suggestions and proposals originating with operating executives should be analyzed and processed by such specialists, along with proposals they originate themselves. In this work they should be assisted by whatever records it is practicable to keep on factors affecting replacement decisions. They should be responsible for the post-audit of earlier replacement decisions to detect any general, or systematic bias in the expectations entering into the original analyses. Finally, and most important, instead of dribbling re-equipment recommendations up to top management one at a time, as is so often done now, they should supply a comprehensive picture of the equipment situation, with a careful estimate of the expenditure required to make each indicated replacement, together with an estimate of the current annual cost of not making it.

Not A Matter of Taste

The traditional techniques used by American industry for analyzing the replaceability of equipment are extraordinarily primitive. Where they involve anything more than intuition, or unaided judgment, they are simply rules of thumb. The most popular of these is the rule that new equipment must "pay for itself" within a stipulated period or must yield a specified "rate of return."

I have asked many business executives how they make up their minds whether to require a two-year or a four-year payoff, and the nearest I have come to a good rationalization is the occasional statement that the requirement employed will use up the available funds. Many executives appear to have their favorite payoff requirement, just as they have their favorite whisky or cigar. One might infer that we are dealing with a matter of taste. Actually, it is much more than that, for the difference between the equipment policy obtained with a two-year payoff requirement and that obtained with a four-year requirement can be the difference between day and night.

This popular rule of thumb affords no practical guide to its own application. For there is no theoretical limit to the shortness of the payoff period to be required, or to the size of the rate of return. Thus, for example, if it is desirable to demand a 50 per cent return before making a replacement, why not ask for 100 per cent? If 100 per cent is good, why is not 200 per cent better? All we have to do to get the 100 per cent or the 200 per cent, as the case may be, is to defer the replacement long enough. We are sure, eventually, to harvest the profits of procrastination.

I do not want to press the absurdities of this logic any further, but come at once to the conclusion. The rule-of-thumb devices traditionally popular in American industry do not make sense. They are simply a piece of industrial

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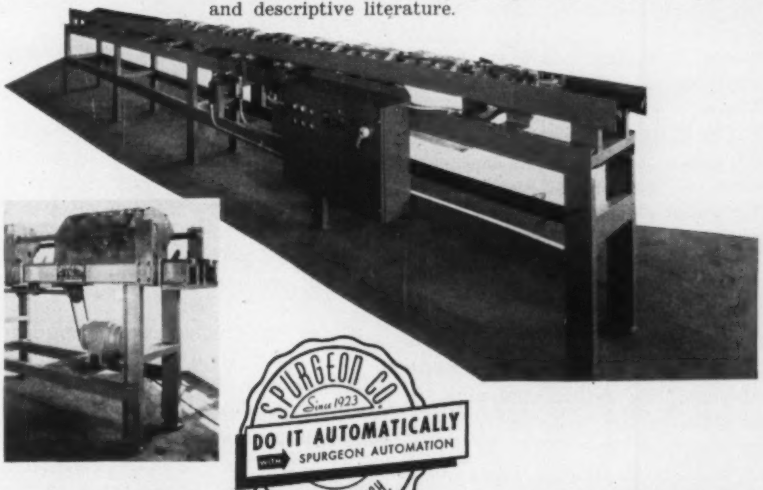

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folklore, handed down from one generation of managers to the next. Their use represents, accordingly, an exercise in mysticism.

If these rule-of-thumb procedures merely yielded capricious results in individual cases, but with no general or systematic bias, they could be regarded with a certain indulgence. It appears, however, with the exceptions to be expected of any generalization, that they operate in the main to delay replacement beyond the point indicated by more rational methods of analysis.

Formula Specifications

The variables in most replacement analyses are too numerous, complex, and unpredictable to permit a fully realistic solution. A formula supplies the simplification required to make the problem solvable. Since the use of formulas is spreading rapidly, and since many companies are considering possible alternatives, it may be worthwhile to set forth the specifications a good formula should meet.

The formula must solve the right problem. — Obviously, the right answer to the wrong problem may be quite as bad as the wrong answer to the right problem. Let me cite one example: Many formulas base the replacement analysis on a comparison of the performance of the present and proposed machines *over the estimated service life of the latter.* Thus, if the new machine is given a life of 10 years, it is assumed that the old machine will be kept 10 years longer.

The difference between the performance of the new equipment over its lifetime and the performance that would be obtainable from the old, if continued in service over the same period, is ordinarily of no significance whatever. Even if the old unit is physically capable of service over the full life of the new—which it often is not—the real choice that confronts the analyst is not between retaining it for that interval or replacing it now; it is between *replacing it now or replacing it later.* The real question is whether there is *any* period of further service for which its retention is advantageous. This question cannot be answered by assuming that it must be kept 10 years or not at all.

The formula must make reasonable and explicit projections for all relevant variables. What are these variables? Let me mention a few: (1) The operating rate; (2) the duration of the operation; (3) operating costs; (4) service deterioration; (5) obsolescence (the cost and performance of machines to be available later); (6) salvage values; (7) the cost of capital; (8) the mix of debt and equity capital; (9) income-tax rates; and (10) tax depreciation methods. There are others.

Any good replacement formula must offer explicit projections for these variables. Only thus can the analyst know what he is assuming when he applies the formula. Only thus is he in a position to appraise the appropriateness of the assumptions to the case in hand and to give proper weight to the results of the analysis.

The formula must take cognizance of future obsolescence.—It is possible to measure the *past* obsolescence of an old machine by comparing its performance with that of its current alternative. It is not possible, however, to say just what the *future* obsolescence of that alternative will be. It is not specifically predictable. Nevertheless, few things are more certain than that it will accumulate obsolescence with time, and that this accumulation will impair its usefulness and figure among the reasons for its retirement.

The importance of obsolescence as a factor in equipment replacement can be illustrated by a recent study of a small sample of analyses involving machine tools. The tentative conclusion emerged—tentative because of the very limited scope of the study—that on the average something like 75 to 80 per cent of the operating advantage of the new machine over the old represented the obsolescence of the latter rather than its physical deterioration. If the truth is anywhere near this, it emphasizes the importance of building into the replacement formula an allowance for the future obsolescence of the presently new equipment.

The formula must allow for differences in service values as well as in costs.—Replacement analyses sometimes go wrong by reliance on the assumption that the service rendered by the old and new equipment is identical; hence, that the only question at issue is the comparative cost of getting it. Certainly this is true in many cases, but in others there are substantial differences in the value as well as in the cost of the service. Dollar for dollar, one difference is as good as the other, a fact that should be recognized and allowed for in the replacement formula.

This allowance should take cognizance not only of the existing service-value differential between the old and the new machines, but also of the possibility that future new machines may render an even more valuable service than the present one. In other words, the obsolescence allowance should cover service-value obsolescence as well as cost obsolescence.

Additional Specifications

The formula must handle mixed replacement-expansion situations. —This requirement is closely related to the preceding one. The service rendered by the proposed equipment may be superior to that of the old, not only in quality but in quantity. In other words, it may provide additional capacity. If this extra capacity is currently usable, it should be taken into account as a credit to the new machine.

The formula must allow for the cost of capital, including the income tax.—The capital tied up in productive facilities is not a free good. If it is obtained by outside financing, it carries a charge in the form of interest or equity return. If it comes from funds already in possession, it carries an "opportunity cost"—it can earn a return in other applications. No comparison of alternatives involving different amounts of capital tie-up—a situation characteristic of replacement analyses—can possibly be correct without allowing for capital cost.

In making this allowance, the replacement formula must take into account the income-tax cost of capital as well as its cost in interest and after-tax return. Since interest payments are deductible, while equity earnings are not, the tax cost varies with the "mix" of capital as between debt and equity. It varies also with the depreciation method allowed for tax purposes.

The formula must allow for present and future salvage values.—The present salvage value of the old equipment is usually taken into account, though not always correctly. But it is rather uncommon to recognize and allow for the future salvage value of the new equipment.

The formula must allow for future capital additions. — Some types of equipment require one or more major capital additions over their service life in the form of rebuilds, overhauls, or heavy renewals. These should be projected and evaluated in the replacement analysis, and the formula should of course provide for their inclusion. It should provide likewise for any capital additions required to keep the old equipment in further service.

The formula must yield the cost of not replacing.—No replacement formula can be considered adequate unless it provides management with a reasonable estimate, based on clearly stated assumptions as to the future, of what it is currently costing in dollars per year not to take advantage of available replacement opportunities. Such an estimate is a precondition of the intelligent administration of equipment policy.

The formula must be simple to apply.—No matter how carefully contrived and "scientific" a replacement formula may be, it will fail of acceptance unless it is "gadgeted" for easy application. Few practicing analysts are willing to work through a half page of algebra to get the answer. It must be obtainable by at most a quick reference to simple charts or tables. No formula can be good in a practical sense without ease of application.

Here, then, are 10 specifications for a good replacement formula. I suggest that you test your present procedures against this standard. If they conform reasonably well, you are well on the way to a good re-equipment policy. If not, you have an unsolved problem.

From a paper entitled, "The Economics of Equipment Replacement By Purchase" presented at the Twenty-fourth Annual Meeting of the American Society of Tool Engineers, in Chicago, Ill., March, 1956.

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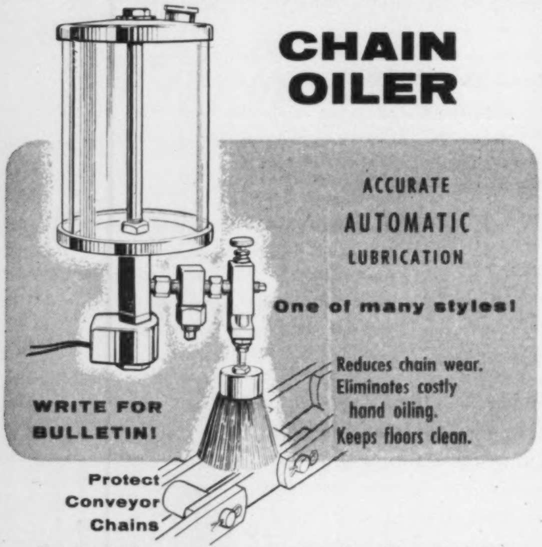

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Vacuum actuated means for raising a support to maintain top of a pile at a desired elevation is controlled by a pile height detector which is a cylinder, ram, sleeve and rod arrangement. Height detector also helps separate sheets in conjunction with vacuum lifters in corners of top sheet. Patent 2,746,753 by Alfred P. Battey, assigned to R. Hoe & Co. Inc.

ANALYZER

Presence of acetylenes is detected by directing two beams of infrared radiation of predetermined intensity through a sample and one of the beams also through a filter of spinel. Changes in ratio of intensities of the beams indicate changes in concentration of acetylenes in the sample. Patent 2,750,511 by Elmer C. Miller, assigned to Phillips Petroleum Co.

CONVEYOR ALIGNING MECHANISM

Alignment of conveyor belt on its supporting rollers is automatically maintained by a double-acting cylinder which positions an end roller in response to valve operation by a belt feeler. Patent 2,751,067 by John H. Nicholson, assigned to Sunkist Growers Inc.

INTERLOCK FOR MANUAL-AUTOMATIC CONTROL SYSTEMS

In an electrical network which may be automatically balanced by a balancing motor or manually controlled, a relay means inhibits motor operation under automatic control until the network is balanced. Patent 2,753,499 by Warren E. Dion, assigned to The Bristol Co.

POTATO DICING MACHINE

Potatoes intermittently advancing in individual pockets of a conveyor are pushed off the conveyor and through stationary dicing knives by a pusher co-ordinated with the conveyor. Patent 2,749,955 by Walter E. Buechele, assigned to Brock & Co. Inc.

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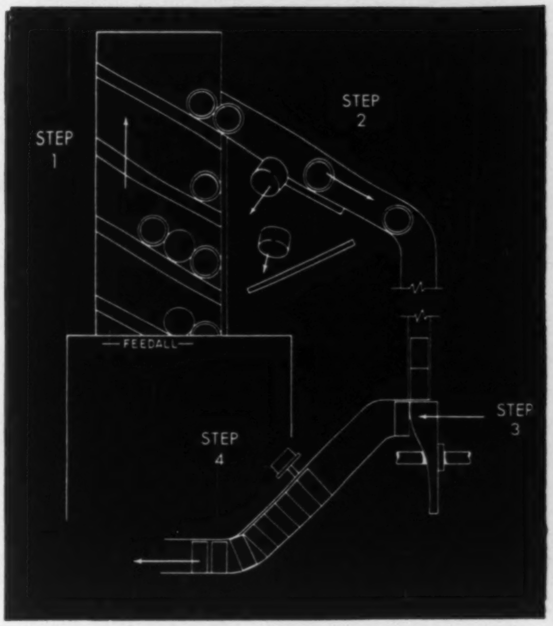

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CUMULATIVE EDITORIAL INDEX

Including six issues. Number preceding the hyphen is month of issue; those following are page numbers in that issue.

A

Abruzzi, A.
  New Horizons in Labor Dignity, 12-38
Adhesive application, 1-9
Air, use of compressed, 9-43
Alodine processing, 12-65
Analog,
  information, 10-84
  systems, 10-137
Analysis,
  electric circuit, 8-122
  gas stream, 11-78; 1-14
Analyzers,
  acetylene, 1-127
  continuous, 8-49
Annealing, 1-68
Anodizing, 12-65
Antonson, W. L.
  Photoelectric Control in Log Handling, 11-58
Assembly, 10-50
  auto wheels, 9-40
  automated, 10-50; 11-63; 12-55; 1-45, 60
  circuit board, 10-68
  continuous, 11-63
  cyclic, 11-63
  electronics, 10-19
Astin, A. V.
  Industry Needs Automation, 9-133
Automation,
  and labor, 12-38; 1-22
  and the public, 1-29
  and smaller plant, 10-63
  controllers, 9-54
  developments needed, 9-133
  economics, 1-40
  evaluating for, 1-40
  history, 12-33
  machine tool field, 8-66; 10-63
  organizing for, 1-51
  philosophy, 12-9, 38; 1-35
  planning for, 12-55; 1-40, 70
  small scale, 1-40
  welding field, 11-33
Automobile,
  manufacture, 1-29
  parts manufacture, 8-55
  wheel assembly, 9-40

B

Balancing,
  automatic, 9-71
Ballizing, 10-75
Batch formulating, 12-46
Batch processing, 11-81; 12-65
Baughman, G. W.
  Automatic Operation of Railroads, 8-116
Bearings, antifriction valve, 9-70
Beer-case handling, 8-37
Black, D. V.
  Bibliography of Literature on Computers, 11-135
Bobbin winding, 12-43
Boiler water corrosion, 9-12
Bolz, R. W.
  Size or Ingenuity? edit., 1-39
Bonding linings, 11-78
Broaching, 11-48
Brown, J. J.
  Potential in Canada, 10-142
Buffing, 1-68
Bulk weighing, 8-44
Burgoyne, A. S.
  Synchronizing Sensing and Processing, 9-49

C

Cameras, 8-16
Canada, automation in, 10-142
Capacitors, ceramic, 12-19
Carrier equipment, remote control, 9-66
Casgrain, W. V.
  Materials Handling Trends, 11-126
Casting, 12-72
  continuous, 11-129
Ceramics, spray system, 8-20
Chemical,
  analysis, 11-25
  pneumatic & electronic controllers, 9-54
  processing, 8-49
Circuits,
  design, 11-131
  molded, 1-14
  self-checking, 8-10
  telephone, 11-50
  triple coincidence, 1-12
Classification system, 12-48
Classifying, 12-67
Close, G. C.
  Pushbutton Metal Treating, 12-65
Coded descriptions, 12-48
Coining, 11-64
Combes, J. J.
  Continuous Analysis Key to Improved Processing, 8-49
Components, 8-30
  electronic, insertion, 10-68
Compressed air use, 9-43
Computers, 10-22, 137; 1-131
  and management, 8-122
  bibliography on, 11-135
Computing, mix proportions, 10-62
Contents, 1-3
Continuous processing, regulators, 1-54
Continuous stream processing, 8-49
Contour forming, 8-41
  machining, 11-131
Control, 8-120
  aircraft throttle, 8-19
  bulk feeders, 12-60
  chemical processes, 8-49
  computers, 10-137
  conveyor, 8-37; 11-58; 12-77; 1-127
  cutoff operation, 10-74
  dc drive, 8-60
  digital, 9-130
  edge position, 1-54
  finishing process, 11-57
  flow ratio, 11-80
  food packaging, 9-46
  gas stream, 1-14
  grinding, 12-76
  grinding operation, 8-13; 12-46
  machine, 9-71
  machine tools, 8-66; 9-12, 130; 10-137; 11-73; 1-70
  memory system, 1-75
  meter-relay, 12-74
  moisture, 9-9
  motor speeds, 12-53
  numerical, 9-130; 10-84; 1-70
  of railroad, 8-116
  overhead crane, 9-10
  pH, 9-78
  photoelectric, 8-41; 11-58; 1-75
  positioning motors, 11-71
  punched card, 11-81
  rolling mill, 11-9
  self checking, 8-10
  speed, 8-110; 10-90; 1-54
  system design, 8-122; 1-54
  tape, 8-115
  temperature, 8-8; 10-78
  template, 8-41; 11-73
  thickness, 10-90
  work handling, 1-120
Controllers, 9-54
  moisture, 9-9
Conveying, 8-37
  newspapers, 10-59
Conveyors,
  control, 12-77
  escapement, 9-41
  gravel, 8-12
  overhead, 1-131
  plastic belt, 12-16
  plastic tube, 1-10
  pneumatic, 8-44
  transfer, 9-44
Corrosion, boiler, 9-12
Counter, for cutoff control, 10-74
Crane control, 9-10
Current limiting switches, 1-65
Cycle, automatic machine, 8-55

D

Data processing, 8-37; 10-12, 62, 148; 11-9, 15, 16, 78; 12-12, 60, 132; 1-10
Data reading, 12-12
Data transmission, 12-137
Daugherty, J.
  Management and Numerical Control, 9-130
Davis, R. E.
  Testing Hydraulic Speed Control, 8-110
Dc drives, 8-60
Definitions, technical, 12-141
Delays for information, 9-49
Design,
  control system, 8-122
  electronic, 8-30
  hydraulic, 10-75
  of automatic sorter, 12-67
  standardization, 12-48
Dialing, automatic, 12-14
Dickey, P. S.
  Instrument Control of Power Plants, 11-123
Differential transformer, 8-13
Digital,
  control, 9-130; 12-129
  encoder, 9-10; 12-60
  information, 10-84
  systems, 10-137
Drives, dc, 8-60; 1-54
  variable speed, 1-54
Dust collection, 11-78

E

Economics, 10-68
Electric circuit analysis, 8-122
Electrode positioning, 10-90
Electrohydraulic handling control, 8-55
Electrohydraulic system, 10-88, 91
Electronics,
  assembly, 10-19
  circuit assembly, 10-68
  control, 9-54
  harness assembly, 1-12
  reliability of, 8-30
Electrostatic paint spraying, 8-46
Elevator conveyor, 8-54
Enamel, porcelain, 8-46
Engineering for automation, 8-29; 1-57
Engineers,
  processing, 11-33
  welding, 11-33
Equipment replacement, 1-122
Escapements, 10-50
Evaluation for automation, 1-40

F

Facsimile reproduction, 11-10
Fastening, 10-50; 11-64
Feedback, 9-130; 10-137
Feeders, 8-48; 10-50; 1-45
  press, 12-72
Feeding, 8-25; 11-129
  assembly components, 10-50
  dry foods, 9-46
  press brake, 8-41
Filling, cans, 1-61
Filling yarn preparation, 12-43
Finishing, 8-46; 11-57
Flame hardening, 11-77
Flash removal, 10-83
Flow measurement, 10-20; 12-14
Flow ratio control, 11-80
Food packaging, 9-46
Forging, machining, 9-64
Formulation, 10-62
Freight car classification, 11-44

G

Gaging, 8-48
  for machine tools, 8-66
  strip thickness, 11-25; 12-73
Geoghegan, R. S.
  Reduce Unnecessary Variety, 12-48
Greenley, H. R.
  Auto Wheel Assembly, 9-40
Grinding, 11-62; 12-64
  control, 12-76

H

Handling, 8-120; 11-129; 12-64; 1-68
  between presses, 8-55; 1-118
  bulk materials, 11-81; 1-69
  controls, 1-120
  conveying, 8-44, 54
  feeding, 10-50; 11-48, 62, 63; 1-127
  for automated lathe, 10-83
  for pipe threading, 12-73
  for warehouse, 12-73
  in cartridges, 12-67
  in news plant, 10-59
  in packaging, 12-62
  logs, 11-58
  scrap, 1-69
  stone, 9-70
Hardening, 11-77
Harder, D. S.
  Manufacturing in the Future, 8-115
Harness assembly, 1-12
Heinz, W. B.
  Electrohydraulic Devices, 10-88
Herchenroeder, L. W.
  Numerical Control of Machine Tools, 10-84
Hole finishing, 10-75
Hoppers, 8-25
Host, J. A.
  Basic Transfer Machine, 10-91
Hydraulics,
  control, 8-55
  machine tool, 8-12; 10-75
  press, 8-41
  speed control, 8-110

I

Indexing, 8-66
Industrial engineering, 12-141
Information, delays, 9-49
In-motion weighing, 11-44
Inserting, electronic components, 10-68
Inspection, photoelectric, 1-75
Instruments, 9-22
  control, 11-123
  liquid weight measuring, 8-13
Integrating automatic operations, 12-43
Interfloor conveyors, 8-54
Interlocks, 1-127
Irradiation control, 12-78

J

Joyce, A.
  Magnetic Memory Links Continuous Inspection and Sorting, 1-75

K

Kendall, G. H., Jr.
  Basic Transfer Machine, 10-91
Kendall, G. H., Sr.
  Basic Transfer Machine, 10-91
Kraft, W. C.
  Aircraft Skin Miller, 11-73

L

Labor, 1-29
Landsness, C.
  Automatic Balancing, 9-71
Lawson, A. A.
  Insertion of Electronic Components, 10-68
Legal problems, 10-148
Level measurement, 12-16
Limit switches, 1-65
  rotary, 12-16
Linear programming, 10-148

- Load cell system, 11-44
- Load surveys, 11-15
- Lubrication, 1-10, 16
  - automatic, 1-61

M

- Machine tools,
  - automated types, 8-66
  - auxiliary equipment, 1-16
  - boring, 9-43
  - broaching, 11-48; 1-14
  - control, 8-13; 9-12, 130; 10-19, 63, 84, 137; 11-73
  - conversion, 11-73
  - drilling, 1-40
  - electronic erosion, 1-12
  - hydraulic slotter, 8-12
  - hydraulic systems, 10-75
  - lathe, 11-12
  - lubrication, 1-10
  - numerical control, 1-70
  - skin milling, 11-73
  - tape control, 10-9
  - tracer control, 11-131
- Machines, 8-121
  - adhesive applying, 1-9
  - assembly, 1-45
  - balancing, 9-71
  - food packaging, 9-46
  - grass growing, 12-22
  - indexing, 1-45
  - packaging, 1-61
  - potato dicing, 1-127
  - replacement policy, 1-122
  - sorting, 12-67
  - wrapping, 1-61
- Magnetic amplifiers, 10-14; 11-71; 12-53; 1-65
- Magnetic memory units, 1-75
- Magnets,
  - manufacture, 8-48
  - testing, 12-78
- Maintenance, 1-61
  - electronic, 8-30
- Management planning, 9-130; 1-40
- Manufacture of,
  - air frames, 8-41; 1-70
  - appliance parts, 8-46
  - automobiles, 8-25; 1-29
  - automobile parts, 9-43; 12-33
  - automobile wheels, 8-55
  - axle housings, 11-33
  - circuit boards, 10-68
  - cloth, 12-43
  - compounded chemicals, 8-44
  - dog food, 8-14
  - flywheels, 9-71
  - motors, 1-60
  - paperboard milk cartons, 1-75
  - permanent magnets, 8-48
  - piston pins, 11-62
  - pistons, 9-43
  - printed circuits, 8-19
  - quartz crystals, 12-67
  - razors, 1-45
  - stampings, 8-55
  - tea bags, 1-61
  - TV components, 8-54
  - valves, 9-64
  - window channel, 1-19
- Manufacturing prediction, 8-115
- Manufacturing research, 8-25
- *Mater, M. H.*
  - Photoelectric Control In Log Handling, 11-58
- Materials,
  - handling, 8-37, 54; 11-14, 126
- Measuring,
  - liquid flow by weight, 8-13
  - mass per unit length, 12-137
  - positioning control, 12-129
- Memory circuits, 1-65
- Memory units, 11-16; 1-75
- *Menard, C. G.*
  - Evaluating Machine Tool Arrangements, 8-66
  - Hydraulic System Improvements, 10-75
- *Merchant, C. O.*
  - Assembling Razors Automatically, 1-45
- Metals, surface treating of, 12-65
- Meter-relays, 12-74
- Metering,
  - liquids, 11-80
  - molten metal, 12-137
- *Milek, J. T.*
  - Bibliography of Literature on Computers, 11-135
- Mixing, dry, 8-44; 10-14
- *Mohler, J. B.*
  - Controlling pH of Process Solutions, 9-78
- Moisture controller, 9-9
- Monitor vibration, 8-22
- Motor,
  - speed control, 12-53
  - tape control, 10-19
- *Murphy, V. R.*
  - Selection of DC Drives and Controls, 8-60

N

- Newspaper handling, 10-59
- *Nitka, N. J.*
  - Testing Hydraulic Speed Control, 8-110
- Numerical control, 9-130; 10-84; 12-129; 1-70
- Nut-setting, 11-65

O

- Organizing for automation, 1-51
- Orienting mechanism, 12-67
- Orienting methods, 10-50
- Ovens, overhead, 1-69

P

- Packaging, 8-14; 9-14; 11-78; 12-62
  - appliances, 12-62
  - dry foods, 9-46
  - machines, 1-61
- Paint spraying, 8-46
- Pallets,
  - handling, 8-54
  - loading, 8-37
  - transfer, 10-91
- Parts selectors, 10-50
- pH,
  - control of, 9-78
  - measurement, 9-12
- Philosophy,
  - automation, 12-38; 1-35
  - education, 11-20
- Photocell,
  - control, 8-41; 11-58; 12-137; 1-75
  - temperature indicator, 10-78
  - weight indication, 12-60
- *Pick, M.*
  - Pulse Counter Controls Cutoff, 10-74
- Planning, 1-40
  - for automation, 12-55; 1-40, 51, 70
- Pneumatic,
  - communication tubes, 8-37
  - controllers, 9-54
  - conveying, 8-44
  - symbols, 12-141
- *Popoli, F. R.*
  - Applying Telephone Switches and Relays, 11-50
- Porcelain enamel, 8-46
- Positioning, 10-50
  - control, 11-71; 12-129, 139
- Presses,
  - automated, 12-72
  - brake, 8-41
  - unloaders, 1-118
- Printed circuits, 8-19; 1-14
- Printing, 1-75
  - newspapers, 10-59
- Procedures, automation projects, 12-55
- Process,
  - controllers, 9-54
  - design, 11-129
  - development, 8-25
- Processing, chemical, 8-49; 12-65
- Programming, 10-68
- Project analysis, 12-55
- Proportioning, 11-80; 12-46
- Proximity limit switch, 1-65
- Pump, chemical resistant, 10-20
- Pumping, controlled volume, 12-141
- Punched cards, 10-68
  - batching control, 11-81
  - rolling mill control, 11-9
- Punched tapes, 1-70

R

- Radio, civil defense, 10-9
- Railroad, 8-116
  - car weighing, 11-44
- Random processes, control, 10-148
- *Redner, K. H.*
  - Packaging Dry Food Products, 9-46
- Regulators, motor, 1-54
- *Reiter, R. E.*
  - Preparing for Numerical Control, 1-70
- Relays, electrohydraulic jet pipe, 10-88
  - electromagnetic, 1-131
  - telephone type, 11-50
- Reliability, electronic, 8-30
- Remote control, 10-14
  - via voice frequencies, 9-66
- Reproduction, facsimile, 11-10
- Research, 8-25
- Resistors, temperature sensitive, 9-69
- *Reynolds, H. L.*
  - Photocells Control Versatile Press Brake, 8-41
- Riveting, 11-64

S

- *Saint-Amour, P.*
  - Using Meter-relays, 12-74
- Sampling, chemical, 8-49
- Sand preparation, 12-46
- Saturable reactors, 11-71; 12-53; 1-65
- *Scollard, W. E.*
  - Auto Wheel Assembly, 9-40
- Screwdriving, 11-65
- *Seidel, R. B.*
  - Tailoring Automation To Plant Needs, 10-63
- *Seifried, A. G.*
  - Regulators at Work, 1-54
- Selection of dc drives, 8-60
- Semi-conductor, thermistor, 9-69
- Servosystem, 1-14
- *Sherman, D. W.*
  - Organizing for Automation, 1-51
- Shipping, 8-37
- Simplification, 12-48
- *Slattery, T. G.*
  - Magnetic Memory Links Continuous Inspection and Sorting, 1-75
- Small plant automation, 10-63
- Small plant research, 12-12
- *Smart, W. L.*
  - Porcelain Enamel Applied Electrostatically, 8-46
- Solution, pH controls, 9-78
- Sorting, 8-48; 11-12, 67, 129; 12-67; 1-75
- Special machinery, 8-29
- Speed, control, 8-110; 12-53; 1-54
- Spinning, 11-65
- Spline broaching, 11-48
- Spray system, ceramics, 8-20
- Staking, 11-64
- Stamping, 8-55
- Standardization, 12-38, 48
  - tooling, 9-43
- Standards, 11-131
- Statistics, automation, 10-143
- Steady state, 8-110
- *Stone, J. J.*
  - Computers in Machine Tool Control, 10-137
- Stud-setting, 11-65
- *Sullivan, E. M.*
  - Assembling Razors Automatically, 1-45
- Switches,
  - current limit, 1-65
  - proximity limit application, 1-65
  - telephone type, 11-50; 1-19
  - wattmeter, 1-65
- Switching, railroad, 8-116
- System reliability, electronic, 8-30
- Systems,
  - control, 8-122
  - engineering, 1-131

T

- Tapes,
  - control, 8-115; 10-9; 1-70
  - recording, 11-15
  - steel control, 8-41
- Telemetering, 12-137
- Telephone equipment, 11-50
- Temperature, control, 10-78
- Terminology, 12-48
- Testing,
  - electronic components, 12-14
  - speed control, 8-110
- Theory of games, 10-148
- Thermistors, 8-8; 9-69
- Timing, 9-49
- Tool design, 9-43
- Tracer control, 12-12
- Transfer machines, 8-66; 9-64, 74; 10-91; 11-37, 63; 12-33
  - tooling, 11-15
- Transient response, 8-110
- *Treer, K. R.*
  - Automated Assembly, 10-50; 11-63, 12-55
- *Tucker, D. P.*
  - Reliability of Electronic Equipment, 8-30
- Turning, 10-83

V

- Vacuum melting, 12-72
- Variable speed drives, 1-54
- Vibration monitor, 8-22
- Vibratory feeding, 8-48
- Voice frequency carriers, 9-66

W

- *Waldron, A. J.*
  - Weighs the Advantages of Pneumatics for Process Control, 9-54
- *Walker, J. R.*
  - Applying Magnetic Amplifiers, 11-71; 12-53; 1-65
- Warehousing, 8-37
- Weaving, 12-43
- Weighing, 11-44, 81; 12-60
  - bulk, 8-44; 12-46
- Welding, 11-9, 33, 67, 78; 1-60
- *Welshenbach, C. D.*
  - Packaging Is a Production Problem, 12-62
- *West, R. K.*
  - Automatic Temperature Control, 10-78
- *White, F. F.*
  - Developing Small-Scale Automation, 1-40
- *Wise, L. V.*
  - Special Automatic Sorter, 12-67
- Work morality, 12-38
- Wrapping machines, 1-61
- *Wright, W. O.*
  - Maintenance Improves with Automatic Lubrication, 1-61

Z

- *Zilius, R. B.*
  - in-motion Weighing, 11-44

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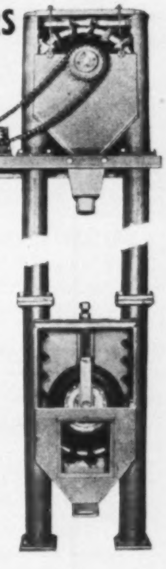

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AGA Division, Elastic Stop Nut Corporation of America ... 89
Allied Radio ... 126
American MonoRail Co. ... 8
Apex Machine & Tool Co., The ... 121
Assembly Products, Inc. ... 133
Autotron, Inc. ... 131

Bell Aircraft Corporation ... 125
Bellows Co., The ... 96
Bell Telephone Laboratories ... 82
Binks Manufacturing Co. ... 93

Cargill-Detroit Corporation ... 85
Cleveland Worm & Gear Co., The ... 13
Clippard Instrument Laboratory, Inc. ... 130
Cutler-Hammer, Inc. ... Back Cover

Dearborn Gage Co., Air Gage Division ... 109
Dertex Chemical Industries, Inc. ... 87
Dynamatics Division, Eaton Manufacturing Co. 31

Eagle Signal Corporation, Industrial Timers Division ... 103
Eaton Manufacturing Co., Dynamatics Division 31
Elastic Stop Nut Corporation of America, AGA Division ... 89
Electronics Corporation of America, Photoswitch Division ... 5
Erickson Tool Co. ... 23

Falk Corporation, The ... 11
Feedall, Inc. ... 127
Filck-Reedy Corporation, Tru-Seal Division ... 112

Garrison Machine Works, Inc. ... 104
Gemco Electric Co. ... 105
Giffels & Vallet, Inc. ... 115
Gray Equipment Co. ... 111

Hapman Conveyors, Inc., A Division of Hapman-Dutton Co. ... 131
Hapman-Dutton Co., Hapman Conveyors, Inc. Division ... 131

KDI Corporation ... 101

Lamson Corporation ... 123
Lansing Stamping Co. ... 126
LeBlond, R. K., Machine Tool Co., The ... 32, 33
Logansport Machine Co., Inc. ... 119
Lovejoy Flexible Coupling Co. ... 16

Magnus Chemical Co., Inc. ... 37
Master Electric Co., The ... Inside Back Cover
Matthews, Jas. H., & Co. ... 117
Mead Specialties Co. ... 19
Modernair Corporation ... 95

North Electric Co. ... 22

Oil-Rite Corporation ... 126
Ortman-Miller Machine Co. ... 110

Packmaster Sales Co. ... 130
Peerless Electric Co., The ... 25
Photoswitch Division, Electronics Corporation of America ... 5
Planet Corporation ... 81

Reliance Electric & Engineering Co. ... 26, 27
Ross Operating Valve Co. ... 1

Schrader's, A., Son, Division of Scovill Manufacturing Co., Inc. ... 34
Scovill Manufacturing Co., Inc., A. Schrader's Son Division ... 34
Snyder Tool & Engineering Co. ... 6, 7
Southwest Products Co. ... 126
Spurgeon Co. ... 123
Standard Electrical Tool Co., The ... 130
Swanson-Erie Corporation ... 113

Thayer Scale & Engineering Corporation ... 101
Tru-Seal Division, Flick-Reedy Corporation ... 112

United States Drill Head Co., The ... 89

Versa Products Co., Inc. ... 91
Verson Allsteel Press Co. ... 28

Wean Equipment Corporation ... Inside Front Cover
West Coast Electrical Manufacturing Corporation ... 107
Westinghouse Electric Corporation ... 20, 21, 36
Wiegand, Edwin L., Co. ... 38

Yoder Co., The ... 2

Zenith Electric Co. ... 112

Consulting Engineers' Service ... 132

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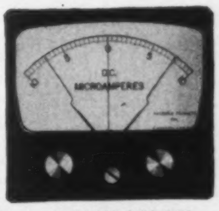

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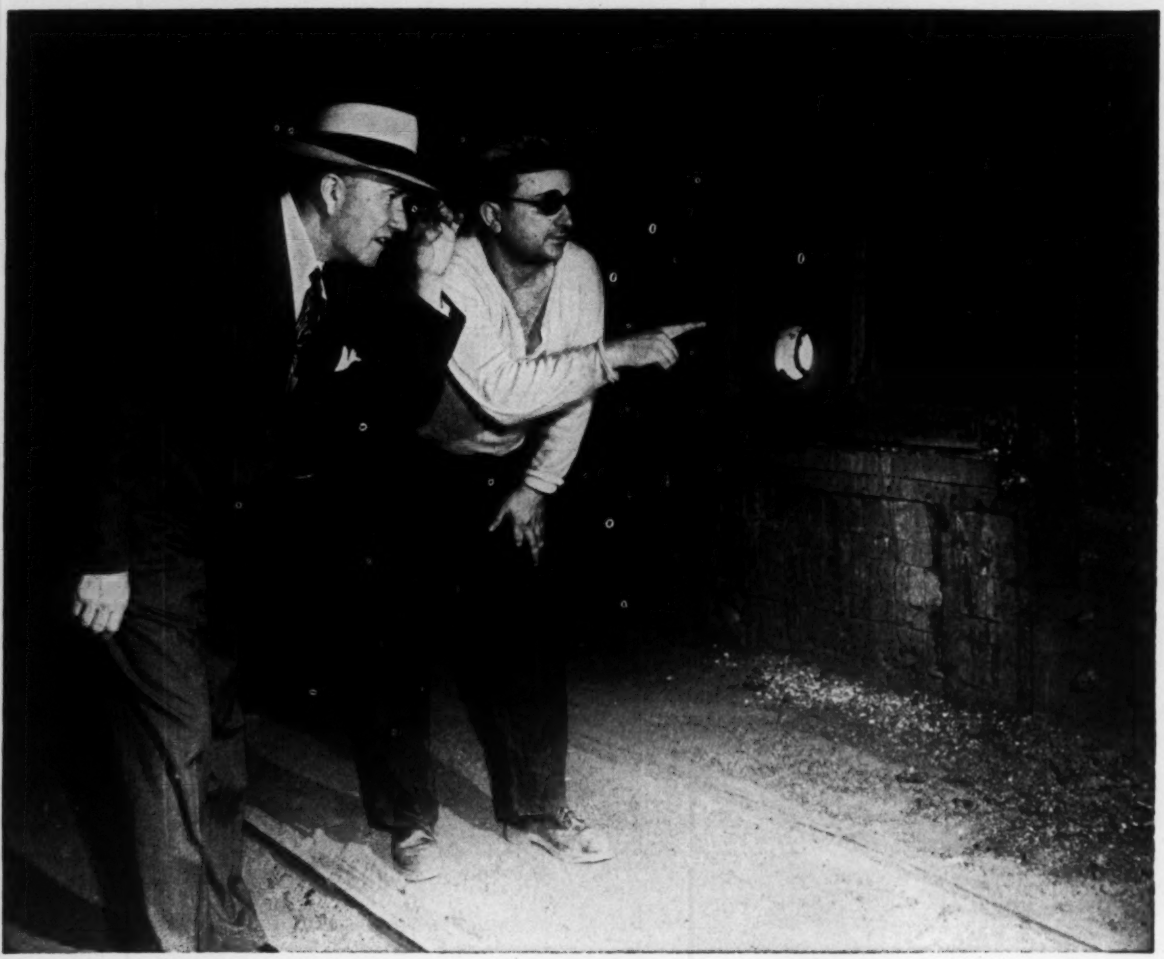

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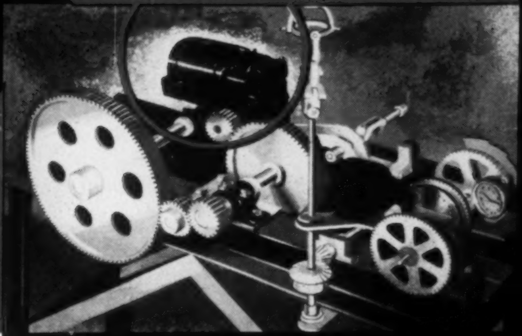

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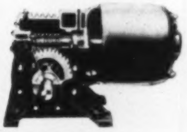

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Speeds	Single-speed, multi-speed, and variable speed.
Installation	Horizontal and vertical, with or without flanges and other features.
Power Drive Features	Electric brakes (2 types)—5 types of gear reduction up to 432 to 1 ratio. Mechanical and electronic variable speed units—fluid drives—every type of mounting.

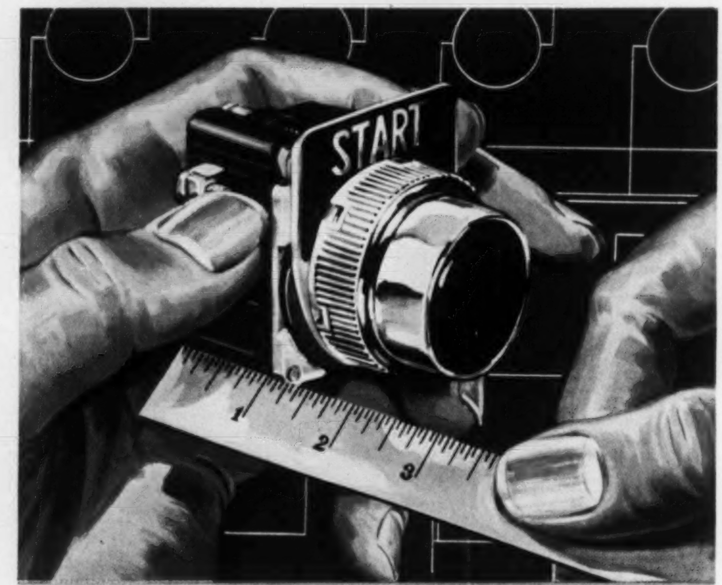
THE MASTER ELECTRIC COMPANY

Dayton 1, Ohio

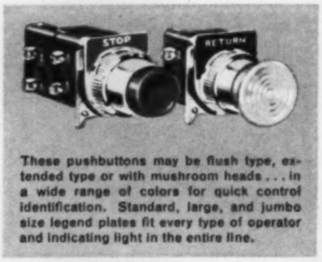
Circle 552 on Inquiry Card

☆ ☆ ☆

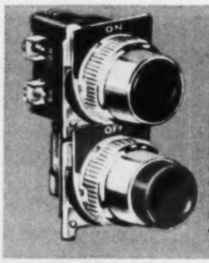
Machine designers say these new heavy duty pushbutton units have no equal and prove it by adopting them as standard equipment



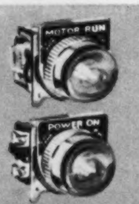
These are the world's smallest heavy duty pushbuttons. They require a behind-the-panel depth of only 1 3/32". This is 40% less space than needed by the next smallest units on the market. Double-pole contact blocks are available in all combinations of normally open and normally closed contacts. Each control circuit is electrically and mechanically isolated from the other. Each circuit is clearly identified and all terminals are color coded. Rapid on-the-job circuit additions are obtained by stacking contact block on contact block.



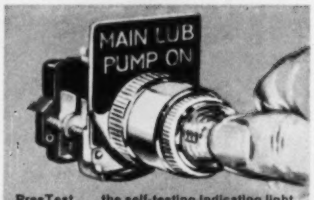
These pushbuttons may be flush type, extended type or with mushroom heads . . . in a wide range of colors for quick control identification. Standard, large, and jumbo size legend plates fit every type of operator and indicating light in the entire line.



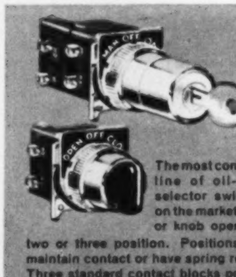
A maintained-contact pushbutton assembly that saves more than its entire cost by installation savings. New attachment with its pushbuttons mount in minutes; no fussy adjustments. Neither alignment nor spacing of units is critical. Pushbuttons will not bind or stick; always operate perfectly.



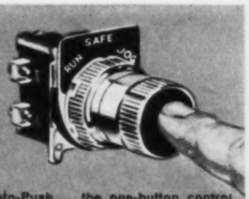
The C-H one-hole mounting oil-tight indicating lights with new wide-visibility lenses are the most visible from all angles by actual light meter tests. Available in either transformer or resistor types. Lenses offered in six different colors.



PresTest . . . the self-testing indicating light. Vital to safety and proper use of machines, particularly in automation. PresTest now permits instant proof light is NOT off because of burned-out bulb. Merely pressing on the light lens disconnects bulb from its normal circuit and checks it on a test power supply. Resistor and transformer types available.



The most complete line of oil-tight selector switches on the market. Key or knob operated; two or three position. Positions may maintain contact or have spring return. Three standard contact blocks provide a wide range of circuit combinations with the use of just a single block. Unlimited circuitry by adding blocks.



Roto-Push . . . the one-button control station. One Roto-Push can provide all the control functions for which two or three separate pushbuttons would be used normally. Available in a wide range of selector and button operators, Roto-Push simplifies panel design and saves installation time to cut costs. Improves machine-operator efficiency.

- ☆ *they install easier*
- ☆ *they work better*
- ☆ *they last longer*

Design engineers are quick to recognize that these new heavy duty pushbuttons have *everything*. There is nothing on the market like them. They are amazingly compact to require the least back-of-panel depth. They are one-hole mounting and they are oil tight. They easily provide for as many as eight separate control circuits per pushbutton, eight completely isolated heavy duty contacts either normally open or normally closed. The buttons may be flush type, the extended type or with mushroom heads. They can be black, red, yellow, green or gray. See the new one-button control station, C-H Roto-Push. See the easiest-to-install maintained-contact pushbutton attachment and the means for padlocking any of the standard pushbuttons. There are both knob and key operated selector switches in this complete line. Also matching indicating lights and the new automation safety light, PresTest. Be sure you have complete information *now*. Write today on your company letterhead for a copy of the new Cutler-Hammer Panel Builders Handbook Pub. EE-120. CUTLER-HAMMER, Inc., 1466 St. Paul Ave., Milwaukee 1, Wisconsin.

CUTLER-HAMMER
★ ★ ★
MOTOR CONTROL
C-H

Circle 553 on Inquiry Card